Standard for the Operation of Swimming Pools and Spa Pools

in South Australia

Revised 2013

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SA Health

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Foreword

Under the *South Australian Public Health Act 2011* (the Act), the Minister can initiate measures to promote proper public and environmental health standards within the State. This Standard for the Operation of Swimming Pools and Spa Pools in South Australia (this Standard) was developed to assist local councils in the administration of the legislation.

Pursuant to sections 109(3) and 109(5) of the Act, the South Australian Public Health (General) Regulations 2013 (the General Regulations) adopt and prescribe sections of this Standard relating to the disinfection of public swimming pools and spa pools in South Australia under regulations 8(1) and 9(1). Regulation 3 details the facilities to which the provisions of this Standard apply and defines the circumstances of application. Non-compliance with the provisions applicable to swimming pool and spa pool disinfection is a breach of the General Regulations and subject to penalty as indicated in regulations 8(6) and 9(7).

This Standard has been prepared to address the issue of water quality in relation to the operation of public swimming pools and spa pools. It details the measures necessary to ensure that water quality within a public pool is of a standard that protects public health.

It describes in detail the disinfection of pool water with reference to other important parameters such as pH, water clarity and total alkalinity that must be maintained in balance as part of the total water treatment process.

Other areas covered by this Standard include an explanation of the chemistry of the disinfection processes, pool water pollutants and potential health effects as a consequence of inadequate pool water treatment.

This Standard informs agencies responsible for the administration of the General Regulations and operators of public swimming pools and spa pools.

1. Introduction

This Standard for the Operation of Swimming Pools and Spa Pools in South Australia (this Standard) applies to swimming pools, spa pools, waterslide and hydrotherapy pools as defined by the South Australian Public Health (General) Regulations 2013 (the General Regulations).

The growing popularity of swimming and other water activities for sport, fitness, therapy or relaxation has led to the increased use of swimming pools and specific-use pools such as spa pools, waterslides, hydrotherapy pools and wave pools.

Pools are used by many people of varying age and health status. Bathers introduce a range of pollutants to pool water, including micro-organisms, saliva, fat, urine, skin, hair, sunscreen lotion and other foreign matter.

Pool owners have a duty of care to provide facilities that are safe, hygienic and comfortable for bathers.

Microorganisms that can cause eye, ear, skin and intestinal infections can live and multiply in pool water that has not been properly treated. In South Australia, fatal cases of amoebic meningoencephalitis have been associated with poorly maintained pools, and inadequate chemical balance of pool water can cause skin rashes and conjunctivitis.

This Standard details the essential requirements to maintain balanced water chemistry within public swimming pools, spa pools, and waterslide and hydrotherapy pools.

Spa and hydrotherapy pools present a greater infection risk than swimming pools if they are poorly maintained. The warm aerated water provides an ideal environment for the rapid growth of many infectious microorganisms. With large numbers of people entering the relatively small volume of water in a spa the organic and microbial loading may be high. This can affect the water quality in a spa and put the health of users at risk. Poorly maintained spa pools have been implicated as a source of skin infections and Legionnaires' disease. If well balanced and operated, spa and hydrotherapy pools can provide a safe, relaxing and enjoyable experience.

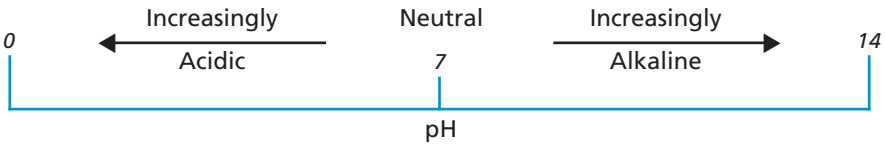
This Standard sets out the approved methods of disinfection of public swimming pools, spa pools, and waterslide and hydrotherapy pools. It has been prepared as a guide to assist local councils with the administration of the *South Australian Public Health Act 2011* (the Act) and the General Regulations, and is a useful guide for pool owners and operators to assist them with compliance.

2. Definitions

the Act	*South Australian Public Health Act 2011*
acidic	water with pH <7.
algae	a very large and diverse group of simple, primarily aquatic and typically autotrophic organisms, ranging from unicellular to multicellular forms.
algaecide	a chemical used to kill algae.
automatic dosing and monitoring equipment	equipment that continuously analyses and controls disinfectant and pH levels in pool water.
backwash	the process of cleaning a swimming pool filter by reversing water flow through the filter.
bather load	the number of persons in a pool at any given period of time.
BCDMH	1-bromo-3-chloro-5,5-dimethylhydantoin.
bromine	hypobromous acid/hypobromite ion (irrespective of the mode of addition or formation).
chlorine	hypochlorous acid/hypochlorite ion (irrespective of the mode of addition or formation).
combined bromine	bromine that has combined with ammonia, ammonium compounds or organic matter containing nitrogen to form bromamines.
combined chlorine	chlorine that has combined with ammonia, ammonium compounds or organic matter containing nitrogen to form chloramines.
disinfecting agent	a compound or substance which, when applied as instructed to swimming or spa pool water, kills harmful microorganisms.
filter	a device for removing suspended particles from pool water.
filter medium	a substance used to entrap suspended particles as pool water passes through it.
flume	an artificial channel or trough which conducts water and is used to transport persons from a raised platform to a receiving waterslide pool.
free bromine	bromine that has not combined and is free to kill bacteria and algae and destroy organic pollutants introduced into the pool water.
free chlorine	chlorine that has not combined and is free to kill bacteria and algae and destroy organic pollutants introduced into the pool water.
the General Regulations	South Australian Public Health (General) Regulations 2013
hydrotherapy	immersion in water for the treatment of illness or injury or for fitness exercising.
hydrotherapy pool	a pool containing heated water and specially designed to meet the therapeutic needs of persons of any age with impairments due to illness, injury, disease, intellectual handicap or congenital defects or for fitness exercise.
knowledgeable person	a person with appropriate knowledge and experience to control, manage and operate a public pool to ensure that the pool water complies with the requirements of the General Regulations under the Act.
lint strainer	a device provided to screen out lint and debris.
make up water	water used to replace lost pool water.
mg/L	milligrams per litre.

operator — a person who has control and management of a public pool, is knowledgeable in its operation and is sufficiently competent to ensure that the pool complies with the requirements of the General Regulations.

owner/occupier — in relation to premises, means a person who has, or is entitled to possession or control of the premises and includes a person who is in charge of the premises. A reference to an owner of premises includes a reference to an occupier of the premises.



pathogenic bacteria — disease causing microorganisms.

pH — a scale (ranging from 0 to 14) that indicates the acidity (0 to <7) or alkalinity (>7 to 14). Water with a pH of 7 is neutral.

pool water inlet — a point where the treated water is returned to the pool from the treatment plant.

pool water outlet — a point where pool water is taken from the pool.

primary amoebic meningoencephalitis — a rare fatal disease caused by the organism *Naegleria fowleri* which enters the body through the nose.

recirculating system — a system of pipes, pumps, filters and devices which enable water to be taken from a pool, subjected to treatment and then returned to the pool.

relative humidity — the ratio of the pressure of water vapour in the air at any time to the pressure of water vapour that would saturate the air.

sand filter — a device utilising sand and gravel as the filter medium.

shock dose — the addition of disinfectant to pool water to achieve a concentration of at least 10mg/L free chlorine or 20mg/L bromine for the destruction of combined chlorine or combined bromine, algae, and other impurities.

skimmer gutter — a drainage system provided to collect surface water flow from a pool and return it to the treatment plant or to waste.

skimmer weir — a device provided to ensure that pool water is drawn from the surface for return to the treatment plant or to waste.

spa pool — as defined in the General Regulations.

stabiliser — a compound which is added to pool water to reduce chlorine loss due to sunlight.

superbromination — the addition of sufficient bromine to pool water to raise the concentration of bromine to at least 20mg/L for the destruction of combined bromine (bromamines), algae and other impurities.

superchlorination — the addition of sufficient chlorine to pool water to raise the concentration of free chlorine to at least 10mg/L for the destruction of combined chlorine (chloramines), algae and other impurities.

swimming pool — as defined in the General Regulations.

total alkalinity — a measure of the total amount of dissolved alkaline compounds in the pool water.

total chlorine — the sum of combined chlorine and free chlorine.

total dissolved solids — a measure of the total amount of dissolved inorganic compounds in the pool water.

turbidity — the degree to which suspended particles in pool water obscure visibility.

turnover rate	the period of time it takes to circulate an amount of water equivalent to the total volume of the pool or spa through the filter.
UV+H_2O_2	ultraviolet light plus hydrogen peroxide disinfection system.
µWs/cm2	microwatt seconds per centimetre squared.
waterslide	consists of a specially designed flume on a supporting structure with a receiving splash pool at the base of the flume.
waterslide pool	an artificial body of water used to receive persons discharged from a waterslide flume.

3. Management

If a swimming pool, spa pool, hydrotherapy pool or waterslide is available for use by the public, the owner of the facility must ensure that the pool is under the control and management of a person who is knowledgeable and competent to operate the plant and maintain the pool water quality. Whilst the facility is available for use by the public it is the responsibility of the owner and the pool operator to ensure pool water quality is maintained in accordance with the requirements of the General Regulations.

Owners of pools covered by the General Regulations are responsible for ensuring the pool is correctly operated. Failure to do so could result in legal proceedings being implemented for non-compliance.

If the operator of a pool fails to maintain pool water quality in the manner prescribed, the relevant authority may deem the operator not to be competent and require the owner to engage a person who is competent.

4. Water clarity

Clarity of pool water refers to the clearness or lack of cloudiness of the water and may be regarded as the distance through the water at which an object can be seen. Under the General Regulations the clarity of pool water must be such '*that a matt black disc, or a disc that contrasts with the colour of the bottom of the pool, 150mm in diameter, is (or would be) clearly visible at the deepest part of the pool*'. Removal of suspended and colloidal matter by filtration assists in maintaining pool water clarity.

The purpose of maintaining clarity in swimming pools, hydrotherapy pools, spa pools and waterslides is to:

> Ensure effective disinfection

> Enable persons to estimate depth, to see subsurface hazards easily and to detect submerged pool users

> Provide a pleasant, attractive and appealing appearance to the water.

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

> Poor water quality

> Poor cleaning practices

> Bathers beneath the surface.

5. pH and total alkalinity

The pH of swimming pool, spa pool, and hydrotherapy or waterslide pool water can affect the disinfection efficacy. It can also affect the pool surfaces, metal fixtures, pipework, pumps and bather comfort. If the pool water is disinfected with chlorine the pH factor is much more critical. Therefore, the pH range must be limited and its tendency to fluctuate must be controlled by ensuring a minimum concentration of total alkalinity. For the purpose of this Standard total alkalinity is measured as calcium carbonate ($CaCO_3$).

Pool water disinfected with chlorine, bromine or UV plus hydrogen peroxide requires a minimum total alkalinity concentration of 60mg/L. However, if gaseous chlorine or BCDMH bromine (refer section 6.4) is used, the minimum recommended total alkalinity concentration is 150mg/L. This ensures that the water is chemically balanced and can be effectively disinfected.

Total alkalinity concentrations greater than 200mg/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 pool.

Tables 1 to 6 (refer section 10) detail the pH and total alkalinity values for disinfected pool waters.

6. Disinfecting agents

To minimise the risk of infection to bathers, public pool water must be disinfected with an agent that is:

> Specified in the General Regulations or

> Otherwise approved in this Standard.

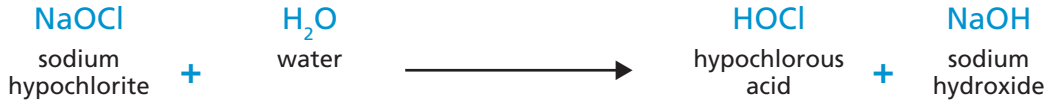
6.1 Chlorine

Chlorine is a disinfecting agent that is able to oxidise most pollutants not removed by filtration. Chlorine concentration must be controlled, as low concentrations are ineffective and high concentrations can cause eye, skin and respiratory irritation.

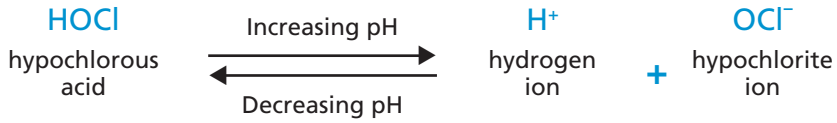
Pursuant to regulations 8(4) and 9(6) of the General Regulations, public swimming pools and spa pools must be immediately closed to the public if the total chlorine concentration in the water exceeds 10mg/L.

Most swimming pools and spa pools are disinfected using chlorine gas or chlorine compounds. These disinfecting agents form hypochlorous acid when they react with water, and therefore they disinfect the pool water in the same manner.

For example, the reaction of sodium hypochlorite with water is:



Hypochlorous acid partly dissociates to give hydrogen ions and hypochlorite ions.



Pool water that is treated with chlorine gas or a chlorine compound will contain hypochlorous acid and hypochlorite ions. Their relative proportions depend on the pH of the pool water (refer figure 1).

Hypochlorous acid is a very effective disinfecting agent. It has low molecular mass and no electrical charge. This allows it to penetrate through bacterial cell walls to attack enzymes. The destruction of the enzymes results in the death of microorganisms.

Hypochlorite ions (OCl^-) are about 100 times less effective as disinfectant that hypochlorous acid (HOCl). This is believed to be because hypochlorite ions are negatively charged and this reduces their ability to penetrate bacterial cell walls which are also negatively charged.

Various chlorinating compounds have differing effects on:

> pH

> Alkalinity

> Total hardness

> Total dissolved solids.

It is essential to maintain the balance of pool water to ensure effective disinfection, bather comfort, and water clarity and to preserve pool surfaces and structures.

6.2 Chlorine stabilised with cyanuric acid

Free chlorine in swimming pool water decomposes when exposed to ultraviolet rays from sunlight. Cyanuric acid and chlorinated cyanurates are used to increase the stability of free chlorine in ***outdoor*** swimming pools.

Cyanurates bind hypochlorite ions into a complex molecule. This reduces the loss of free chlorine as a result of exposure to sunlight and effectively extends the period of disinfection. However, increased chlorine levels are required in stabilised pools because a large amount of the chlorine is attached to the cyanuric acid and is not available for disinfection.

When used in outdoor pools at the prescribed concentration of 30–50mg/L, stabilisers maintain free chlorine residuals for longer periods. Stabiliser concentrations in excess of 50mg/L reduce disinfection efficacy, so it is crucial to ensure the upper limit specified in the General Regulations is not exceeded.

Losses of water by evaporation, splashing, backwashing and vacuuming to waste will gradually reduce the stabiliser concentration and it will require replacement.

The General Regulations prohibit the use of stabilisers in indoor public pools.

pH	Percentage of free chlorine as	
	Hypochlorous acid (HOCl)	Hypochlorite ion (OCl^-)
6.0	97	3
7.0	75	25
7.2 *	63	37
7.5 *	49	51
7.6 *	39	61
7.8	28	72
9.0	3	97
** Mandatory operating range as prescribed by the General Regulations*		

Figure 1

Percentage of free chlorine relative to pH.

6.3 Ultraviolet light plus hydrogen peroxide

The ultraviolet light plus hydrogen peroxide (UV+H_2O_2) system is approved for disinfecting *indoor* swimming pools, spa pools, hydrotherapy pools and waterslide pools up to a maximum 500,000 litres in capacity in accordance with the requirements specified in this Standard.

Disinfection occurs when water is passed through the UV unit. As no residual is produced by UV there is no anti-microbial action in other parts of the system. In order to achieve a residual disinfection capability, hydrogen peroxide must be used in conjunction with UV.

Hydrogen peroxide is a powerful oxidising and anti-microbial agent and in its concentrated form it is a clear liquid with a sharp odour. It provides a residual capacity to oxidise organic material derived from bather load and other sources in a pool. For the UV plus hydrogen peroxide system to be effective ***it must operate 24 hours a day***.

UV has no effect on pH or colour and little effect on the chemical composition of pool water. However, the colour, turbidity and chemical composition of pool water can interfere with UV transmission. Bacteria may be protected by turbidity, clumping and by the presence of slimes so the water must be adequately filtered and treated prior to UV exposure.

UV disinfection is not pH dependent, but the addition of hydrogen peroxide to pool water results in slightly acidic conditions. This requires the pH to be raised to overcome bather discomfort and to protect the pool surfaces, pool water plant and metal fixtures.

To achieve satisfactory pool water chemistry the total alkalinity level must be maintained within a range of 60 to 200mg/L as prescribed by the General Regulations.

6.3.1 Ultraviolet light plus hydrogen peroxide operating criteria

To ensure effective disinfection the UV plus hydrogen peroxide system must achieve:

- A UV dose rate of ≥30,000 microwatt seconds per centimetre squared (μWs/cm^2)
- A flow rate of ≤150 litres per minute through the UV disinfection system while maintaining compliance with the relevant turnover rate prescribed in the General Regulations
- A minimum hydrogen peroxide concentration of not less than 40mg/L within the pool water.

6.4 Bromine

Bromine is approved for disinfecting swimming pools, spa pools, hydrotherapy pools and waterslides in accordance with the requirements specified in this Standard.

Using bromine to treat pool water produces fewer odours than chlorine. Bromine disinfection efficacy is similar to that of chlorine and it is effective over a wider pH range than chlorine. Bromine and chlorine are both destroyed by sunlight, but unlike chlorine, bromine cannot be stabilised against the destructive effects of ultraviolet light.

A number of different methods and bromine producing compounds may be used to bromine disinfect pool water. One common method of producing bromine in pool water involves the addition of sodium or potassium bromide to the water in conjunction with an oxidiser such as sodium hypochlorite or monopotassium persulphate. These substances are available as solutions and they are readily dosed into pool water.

Another common method of using bromine in pool water is to add 1-bromo-3-chloro-5, 5-dimethylhydantoin (BCDMH) to the water. BCDMH is available in tablet or granule form and as it is more acidic (pH 4.5) than some other disinfectants, it will reduce the total alkalinity of pool water more rapidly. To compensate for this, ***if using BCDMH, total alkalinity in the pool water should be maintained within the range of 150mg/L to 200mg/L.***

As with other chemical disinfectants it is sometimes necessary to shock dose the pool water to destroy accumulated organic matter that cannot be reduced through partial replacement of the water. Should it be necessary to shock dose the pool water it should only be done when there are no bathers in the pool. As a disinfecting agent and oxidant, bromine remains active at higher pH levels than chlorine.

In the presence of ammonia, bromine will rapidly form relatively unstable ammonia bromamines which have similar disinfection efficiencies to that of free bromine and do not produce irritating odours. It is therefore unnecessary to destroy ammonia bromamines via breakpoint bromination and superbromination of pool water may not be necessary.

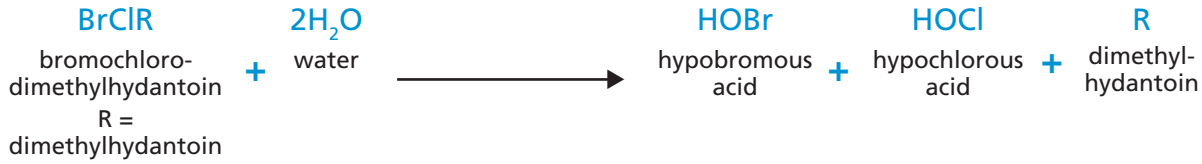
However, for bromine-chlorine disinfection systems, superchlorination of the pool water may be required in order to destroy any chloramines that form. Superchlorination will also convert bromine ions present in the pool water to active bromine and therefore increase the level of free bromine.

All bromine disinfecting agents form hypobromous acid which acts as the pool water disinfectant. Therefore, all of the agents disinfect the pool water in the same manner.

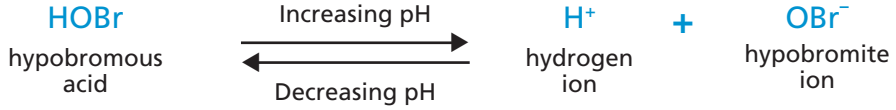
Two methods which may be used to produce hypobromous acid are:

1. The addition of 1-bromo-3-chloro-5, 5-dimethylhydantoin (BCDMH) to pool water
   It may be obtained commercially in tablet or granule form and it is sometimes expressed as bromochlorodimethylhydantoin.

   The following chemical equations show the reactions which take place when BCDMH is dissolved in water.

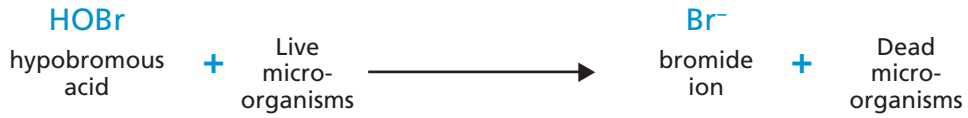


   Hypobromous acid partly dissociates to give hydrogen ions and hypobromite ions.



Pool water that is disinfected with bromine will contain both hypobromous acid and hypobromite ions, their relative proportions depend on the pH of the pool water. See figure 2.

When acting as a disinfectant hypobromous acid produces bromide ions.



The bromide ions react with the hypochlorous acid which was formed when BCDMH dissolved in water to produce hypobromous acid.

Due to the above reactions, hypobromous acid becomes the predominant disinfectant present in the pool water. In practice, hypobromous acid may be the only disinfectant present in the pool water, especially if the bromide ion concentration is relatively high.

It should be noted that hypochlorous acid may be acting as a pool water disinfectant in conjunction with hypobromous acid, particularly after a pool has been filled with replacement water.

2. The addition of sodium bromide together with an oxidizer such as sodium hypochlorite to the pool water. Sodium bromide and sodium hypochlorite are supplied commercially as solutions.

   The following chemical equations show the reactions which take place when sodium hypochlorite and sodium bromide solutions are added to pool water.

   The reaction of sodium hypochlorite with water is:

   Sodium bromide has no disinfecting properties; however, it will react with hypochlorous acid to produce hypobromous acid

   The hypobromous acid produced acts as the pool water disinfectant. However, if the concentration of sodium bromide in the pool water is less than the concentration of hypochlorous acid then some of the disinfection activity will be due to the hypochlorous acid.

6.4.1 Bromamine formation

Hypobromous acid reacts with ammonia and organic nitrogen compounds to form bromamines. The following chemical equations show the reactions of hypobromous acid with ammonia.

NH_3 ammonia + HOBr hypobromous acid → NH_2Br mono-bromamine + H_2O water

NH_2Br mono-bromamine + HOBr hypobromous acid → $NHBr_2$ dibromamine + H_2O water

$NHBr_2$ dibromamine + HOBr hypobromous acid → NBr_3 tribromamine + H_2O water

The bromamines produced by the reaction of ammonia with hypobromous acid are effective disinfectants and assist hypobromous acid in disinfecting pool water. They do not cause eye irritation nor do they have a strong unpleasant odour.

The bromamines formed as a result of hypobromous acid reacting with organic amines from bathers may have disinfection capabilities. They also have greater stability than the ammonia bromamines and their accumulation in pool water may hinder the disinfection of the water. The concentration of these compounds in the water can be reduced by replacing a portion of the water. The quantity and frequency of water replacement will depend on the operating conditions of the pool. However, for spa pools, water replacement must be carried out in accordance with the General Regulations.

pH	Percentage of free bromine as	
	Hypobromous acid (HOBr)	Hypobromite ion (OBr^-)
6.0	100	0
7.0	98	2
7.2*	96	4
7.5 *	94	6
7.6*	91	9
7.8	87	13
8.0	83	17
** Mandatory operating range as prescribed by the General Regulations*		

Figure 2

Percentage of free bromine relative to pH.

7. Disinfection and treatment of water in public swimming pools, spa pools, hydrotherapy pools and waterslide pools

The tables mentioned throughout this section are located in section 10 of this Standard.

7.1 Public swimming pools, wading pools and waterslides

The following conditions must be achieved whenever a public swimming pool, wading pool or waterslide is available for use:

- The pool water must be disinfected with chlorine, bromine or by an ultraviolet light plus hydrogen peroxide system so that the disinfection values set out in tables 1, 4 and 7 are maintained
- The pH, total alkalinity, pool water turnover rate and cyanuric acid concentration (for stabilised outdoor pools and waterslides only) must be maintained in accordance with table 8
- The pool must have a filtration system that provides a continuous circulation of the pool water through the filter
- All water in the pool must pass through the filter as often as necessary to ensure that the water is maintained in a clean and clear condition and in any event a volume equivalent to the total volume of the pool at least once in every six hours for a swimming pool, once every hour for a waterslide pool and once every two hours for a wading pool
- The pool must be fitted with automatic dosing and monitoring equipment that continuously analyses and controls the pH and disinfectant levels in the pool water within the ranges as indicated in tables 1, 4 and 7
- The pool water clarity must be maintained as specified in section 4 of this Standard.

7.2 Public spa pools

The following conditions must be achieved whenever a public spa pool is available for use:

- Spa pool water must be disinfected with chlorine, bromine or by an ultraviolet light plus hydrogen peroxide system in accordance with the values set out in tables 3, 6 and 7
- The pH, total alkalinity and pool water turnover rate must be maintained in accordance with table 8
- A spa pool must be fitted with a filtration system that provides a continuous circulation of water through the filter and passes a volume equivalent to the total volume of the spa pool through the filter at least once in every 30 minutes
- A spa pool must incorporate a weir off-take or skimmer system that continuously takes away surface water whilst the spa pool is in use
- A spa pool must be fitted with automatic dosing and monitoring equipment that continuously analyses and controls the pH and disinfectant levels in the pool water within the ranges as indicated in tables 3, 6 and 7
- Spa pool water clarity must be maintained as specified in section 4 of this Standard
- The water in a public spa pool must be replaced at a rate of at least 20% every day during which it is open for use or the spa pool must be completely drained at least once in every week
- A public spa pool must be cleaned at least once in every week that it has been open for use.

7.3 Hydrotherapy pools

The following conditions must be achieved whenever a hydrotherapy pool is available for use:

- Hydrotherapy pool water must be disinfected with chlorine, bromine or by an ultraviolet light plus hydrogen peroxide system so that the disinfection values set in tables 2, 5 and 7 are maintained
- The pH, total alkalinity and pool water turnover rate must be maintained in accordance with table 8
- A hydrotherapy pool must be fitted with a filtration system that provides a continuous circulation of the pool water through the filter. Ideally the hydrotherapy pool should have its own filtration system. Cartridge filters and diatomaceous earth filters are not recommended
- All water in a hydrotherapy pool must pass through the filter as often as necessary to ensure that the water is maintained in a clean and clear condition and in any event a volume equivalent to the total volume of the pool at least once in every two hours. It is recommended that for heavily used hydrotherapy pools, the water should pass through the filter at least once in every hour
- A hydrotherapy pool must be fitted with automatic dosing and monitoring equipment that continuously analyses and controls the pH and disinfectant levels in the hydrotherapy pool water within the range as indicated in tables 2, 5 and 7
- Hydrotherapy pool water clarity must be maintained as specified in section 4 of this Standard.

NOTE: *Under the General Regulations stabilisers must not be used in any indoor swimming pool, which includes indoor hydrotherapy pools as they are defined in the General Regulations as being swimming pools.*

It is also recommended that stabilisers should not be used in outdoor hydrotherapy pools. The high operating temperature and organic loading found in hydrotherapy pools provides an ideal environment for microbial growth. Therefore a disinfectant which acts rapidly should be used in order to control this growth.

8. Breakpoint chlorination

8.1 Explanation

Breakpoint chlorination is the process of maintaining sufficient free available chlorine in pool water to chemically convert chloramines and ammonia-nitrogen compounds to inert nitrogen gas. The process is described in more detail below and as indicated in figure 3.

When chlorine is first added to the water it is consumed by reducing compounds present in the water as depicted in zone 1 of figure 3.

As further chlorine is added, the level of total chlorine in the water, mainly chloramines, steadily increases until a peak is reached, shown as point A in zone 2 of figure 3. The chloramines, mainly monochloramines, arise from the reaction of chlorine with nitrogenous compounds which have been introduced into the pool by organic matter such as perspiration and urine from bathers. These nitrogenous compounds (e.g. urea, uric acid, amino acids and creatinine) react with chlorine to form monochloramines. Point A in figure 3 depicts the stage when all the nitrogenous compounds in the water have reacted with chlorine to form monochloramines.

Unexpectedly, with the further addition of chlorine, instead of the total chlorine measurement continuing to raise it begins to drop to almost zero as indicated in zone 3 of figure 3. Here the continued addition of chlorine oxidises the monochloramines to dichloramines and the dichloramines to either nitrogen or trichloramines. From this point, indicated as point A in figure 3, the total chlorine level reduces as the monochloramines and dichloramines are oxidised out of solution. At point B, as shown in figure 3, only the stable chloro-organic nitrogen compounds remain. Finally, the continued addition of chlorine results in free chlorine being available in the pool water as indicated in zone 4 of figure 3. Point B, as indicated in zone 4 of figure 3, is known as the 'breakpoint', and the further addition of chlorine will result in increased free chlorine concentrations. It is this free chlorine that disinfects the pool water.

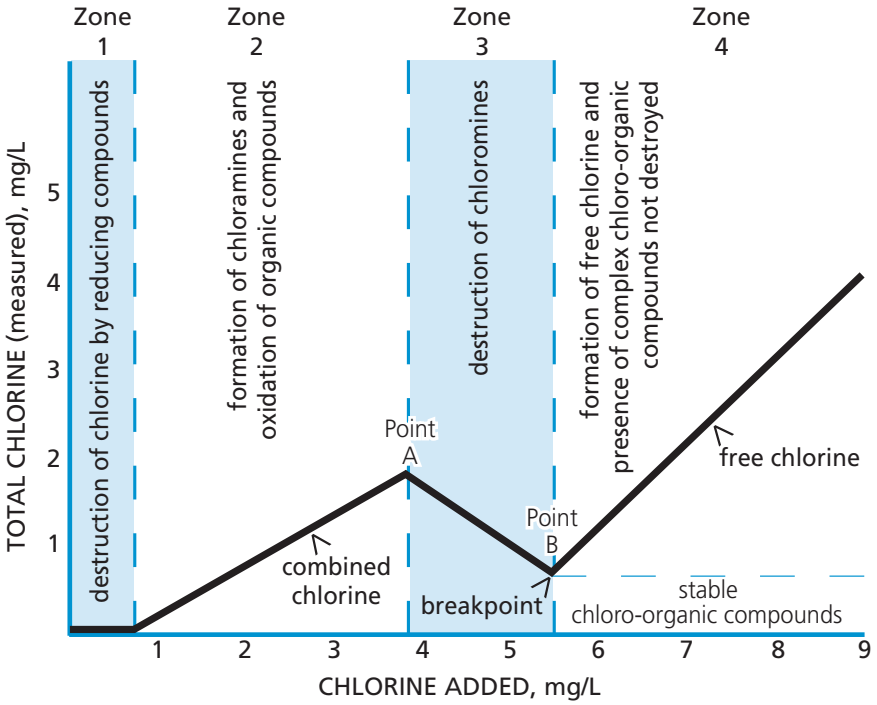
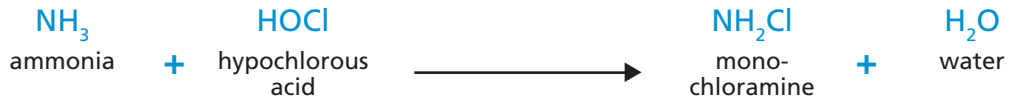


Figure 3

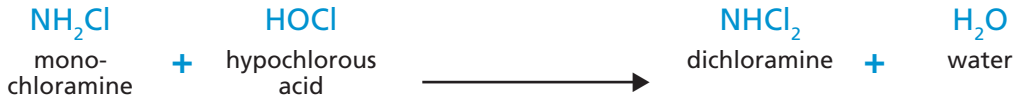
Breakpoint chlorination

8.2 Chloramines

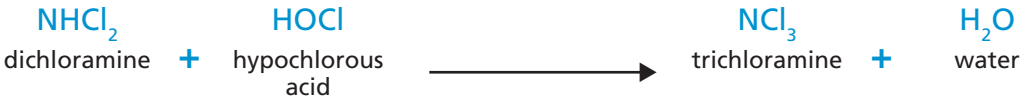
The following chemical equations show the reactions of hypochlorous acid with water containing ammonia from urine, perspiration and other sources to form chloramines.



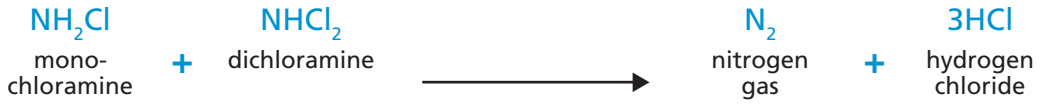
This reaction is usually completed within a minute at pH 7.0 when the chlorine to ammonia nitrogen ratio is 5:1. As the chlorine to ammonia nitrogen ratio begins to increase above 5:1 the monochloramine reacts to form dichloramine.



This reaction is very much slower than the first reaction. Further addition of chlorine before the breakpoint can result in the formation of volatile trichloramine (nitrogen trichloride).



The monochloramine and dichloramine also react with each other to release nitrogen.



The above reactions can be summarised as follows:

Chloramines produce the characteristic swimming pool chlorine smell. Trichloramine is particularly noticeable because it is volatile. Trichloramine is one of a number of chlorinated compounds present in pool water and can cause severe eye irritation.

The trichloramine reaction is increased at low pH levels. The reaction slows as the pH increases; it is minimal at pH 7.5 to 8.0 and does not normally form above this. This is one of the reasons that pH must be maintained within the range of 7.2 to 7.6.

Maintenance of breakpoint chlorination is required to minimise the effects caused by trichloramine.

Not all eye irritation can be attributed to trichloramine. Chlorine can also react with phenolic compounds to form chlorinated phenols which also cause severe eye irritation and an unpleasant taste in the water. Phenols or phenolic compounds are present in a number of cleaning products and their use is not recommended in or around swimming pools and spa pools.

9. Pool pollution

Bathers are the primary source of nitrogenous compounds in public pool water. Nitrogen is introduced to the water via perspiration and urine. Generally children are responsible for the greatest proportion of urine in a public pool. High water and air temperatures increase the rate of perspiration.

Dust, tree leaves and lawn clippings also contribute to the pollution of pool water.

9.1 Algae

Algae are an important contributor to pool pollution. Algae can protect and promote bacterial growth and reduce the efficacy of disinfectants including chlorine. Algae reacts with chlorine to create odours, causes turbidity, discolours pool water and produces slimes that can contribute to accidents in and around a pool.

Remediation of heavy algal growth may require superchlorination of a pool by maintaining a free chlorine level in excess of 10mg/L whilst the pool is not in use. Following this treatment, algae should brush off quite readily. If not, the dose should be repeated until all the algae is destroyed. Dead algae should be physically removed before the pool is made available for use.

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

Algae can also be controlled by the use of algaecide.

9.2 Amoebae

Acanthamoeba species and *Naegleria fowleri* are protozoan organisms naturally occurring in the environment. Under suitable conditions, such as those found in poorly maintained pool water, they can cause a fatal form of meningoencephalitis. Infection occurs when infected water enters the nose. This can happen when diving, jumping or swimming. The amoebae then invade the brain and meninges through the nose. These protozoa are readily destroyed by maintaining the required level of disinfecting agent within the pool water. Refer to tables 1 to 6 (section 10).

9.3 Bacteria

The presence of organic matter in pool water provides a suitable medium for the growth of bacteria, and is derived from humans, animals and the environment. Disinfecting agents are used to destroy or inactivate these harmful bacteria.

Pathogenic micro-organisms found in inadequately disinfected pools include E*scherichia coli, Staphylococcus, Streptococcus, Pseudomonas aeruginosa, Mycobacterium marinum, Salmonella* and *Neisseria* species. *Escherichia coli* are used as an indicator for the presence of faecal pollution. Staphylococci and Streptococci are used as indicators for pollution originating from the nose, throat, mouth and skin of bathers. *Pseudomonas aeruginosa* is an opportunistic pathogen which can cause eye, ear and skin infections in pool users where the pool water is inadequately disinfected. *Mycobacterium marinum* infection causes skin granulomas and can contaminate wet pool surrounds.

9.4 Corrosion products

Corrosion of pool structures is caused by acidic conditions (i.e. a pH of less than 7.0), and can cause the deterioration of structural concrete, cement rendering and other surfaces and can cause tiles to lift. Metal fittings including pumps, ladders, underwater light fittings, heat exchangers and pipework will also corrode. This will effect flow and have an impact on water quality.

It is very important to ensure that pool water is chemically balanced to reduce the effects of corrosion on pool water quality and the materials used in the pool system.

9.5 Organic nitrogen

To ensure effective disinfection of pool water, the presence of organic nitrogen must be controlled. This can be achieved by ensuring breakpoint chlorination is maintained at all times.

A swimmer may lose up to one litre of perspiration per hour when active in pool water at 24°C with an ambient air temperature of 38°C. Perspiration contains sodium chloride, calcium and magnesium salts, and nitrogenous compounds which consist of large amounts of organic nitrogen, ammonia nitrogen, urea, creatinine and amino acids. The pH of perspiration is in the range of 4.0 to 6.8.

The chemical composition of urine includes urea, creatinine, uric acid, hippuric acid and inorganic salts. It is more complex than perspiration and it is difficult to treat because of its high nitrogen content.

Ammonia and urea from perspiration and urine are the main products which adversely affect disinfection. Ammonia nitrogen reacts with chlorine within minutes to form chloramines. However, urea must first go through a hydrolysis reaction before it can combine with chlorine and this can be accelerated by the presence of certain enzymes. This hydrolysis takes three to four hours under normal conditions.

9.6 Viruses

Humans and animals pollute pool water with viruses which can then infect other users. Many viruses can be transmitted from one person to another via pool water. Most viruses, especially enteroviruses, are more resistant to chlorine than bacteria. Adenoviruses are associated with pharyngitis, conjunctivitis and fever. The enterovirus group includes polio, coxsackie and hepatitis A. These agents may produce gastro-enteric infections, jaundice, involve the nervous system and cause a variety of skin rashes.

10. Tables

Table 1

Swimming pools, wading pools and waterslides disinfected with chlorine

Pool water temperature	pH	Total alkalinity mg/L	Unstabilised pool water mg/L		Stabilised pool water mg/L		
	Min – Max	Min – Max	Minimum free chlorine *	Maximum total chlorine *	Minimum free chlorine *	Maximum total chlorine *	Min – Max cyanuric acid
≤ 26° C	7.2 – 7.6	60 – 200**	1.0	Free chlorine as measured +1.0	2.0	Free chlorine as measured +1.0	30 – 50
> 26° C	7.2 – 7.6	60 – 200**	2.0	Free chlorine as measured +1.0	4.0	Free chlorine as measured +1.0	30 – 50
*	Disinfection values						
**	If gaseous chlorine is used the total alkalinity value should be in the range 150 – 200 mg/L						
NOTE:	***Stabilisers must not be used in indoor swimming pools, wading pools or waterslides***						

Table 2

Hydrotherapy pools disinfected with chlorine

Pool water temperature	pH	Total alkalinity mg/L	Unstabilised pool water mg/L	
Ideal	Min – Max	Min – Max	Minimum free chlorine *	Maximum total chlorine *
28° – 35° C	7.2 – 7.6	60 – 200**	2.0***	Free chlorine as measured +1.0
*	Disinfection values			
**	If gaseous chlorine is used the total alkalinity value should be in the range 150 – 200 mg/L			
***	For hydrotherapy pools operating at the upper temperature limit and under heavy bather loads it is recommended that the residual free unstabilised chlorine concentration be at least 4.0mg/L			
NOTE:	***Stabilisers must not be used in indoor hydrotherapy pools and it is recommended that they are not used in outdoor hydrotherapy pools***			

Table 3

Spa pools disinfected with chlorine

Temperature		pH	Total alkalinity mg/L	Free chlorine mg/L	Total chlorine mg/L
Ideal	Maximum	Min – Max	Min – Max	Minimum	Maximum total chlorine
35° – 37° C	40° C	7.2 – 7.6	60 – 200	4.0	Free chlorine as measured +1.0
NOTE: Stabilisers must not be used in spa pools					

Table 4

Swimming pools, wading pools and waterslides disinfected with bromine

Pool water temperature	pH	Total alkalinity mg/L	Bromine mg/L
	Min – Max	Min – Max	Min – Max
< 26° C	7.2 – 7.8	60 – 200*	2.0
≥ 26° C	7.2 – 7.8	60 – 200*	4.0
* Where BCDMH is used as the pool water disinfectant the total alkalinity should be maintained in the range 150-200mg/L			

Table 5

Hydrotherapy pool water disinfected with bromine

Pool water temperature	pH	Total alkalinity mg/L	Bromine mg/L
Ideal	Min – Max	Min – Max	Minimum
28° – 35° C	7.2 – 7.8	60 – 200*	4.0**
* Where BCDMH is used as the pool water disinfectant the total alkalinity should be maintained in the range 150-200mg/L			
** For hydrotherapy pools operating at the upper temperature limit and under heavy bather loads, it is recommended that the bromine concentration be at least 8.0mg/L			

Table 6

Spa pools disinfected with bromine

Pool water temperature		pH	Total alkalinity mg/L	Bromine mg/L
Ideal	Maximum	Min – Max	Min – Max	Minimum
35° – 37° C	40° C	7.2 – 7.8	60 – 200*	8.0
* Where BCDMH is used as the pool water disinfectant the total alkalinity should be maintained in the range 150-200mg/L				

Table 7

Operating criteria for the ultraviolet light plus hydrogen peroxide system

Ultraviolet light	≥ 30 000 µWs/cm²*
Pool water flow rate	≤ 150 L/min
Hydrogen peroxide (H_2O_2) level	≥ 40 mg/L*
pH	7.2 – 7.6
Total alkalinity	60 to 200 mg/L
* Disinfection values	
NOTE: The ultraviolet light plus hydrogen peroxide system is only approved for use in **indoor** ***swimming pools, spa pools, hydrotherapy pools and waterslides with a maximum capacity of 500 000 litres***	

Table 8

Swimming pool, spa pool, hydrotherapy pool and waterslide characteristics

Characteristics	Range: Min – Max	Comments	
pH	7.2 – 7.6	If pH is below 7.2, there is the possibility of: - eye discomfort due to accelerated formation of chloramines - rapid loss of chlorine - etching of exposed cement finished pools, and - corrosion of metals	If pH is above 7.6, there is the possibility of: - reduction of chlorine disinfection efficiency - increased chlorine requirement - eye discomfort - drying of skin - cloudy water - scale formation
Total alkalinity when disinfected with: - calcium hypochlorite - sodium hypochlorite - salt chlorinator - gaseous chlorine - BCDMH bromine	 60 – 200mg/L 60 – 200mg/L 60 – 200mg/L 150 – 200mg/L 150 – 200mg/L	If total alkalinity is below 60, there is the possibility of: - pH fluctuation due to weak buffering effect - corrosion of metals	If total alkalinity is above 200 there is the possibility of: - high pH - cloudy water - scale formation
Stabiliser (outdoor pools only) cyanuric acid	30 – 50mg/L	If stabiliser value is below 30 the chlorine residual is rapidly destroyed by sunlight	If stabiliser value is above 50 the time to destroy pathogenic organisms becomes unacceptably long
Pool water turnover rate	≤ 6 hours for swimming pools ≤ 1/2 hour for spa pools ≤ 1 hour for waterslides ≤ 2 hours for wading pools or hydrotherapy pools		
Temperature	Swimming pools and waterslides – 28° C max Spa pools – 40° C max Ideal 35° - 37° C Hydrotherapy pools – Ideal 28° - 35° C	If the temperature is too low, bathers may experience discomfort	If the temperature is too high there is the possibility of: - increased use of chlorine - bather discomfort - increased evaporation - increased scaling potential
NOTE: Stabilisers must not be used in indoor swimming pools, hydrotherapy pools, spa pools or waterslides			

Table 9

Potential health effects associated with swimming and spa pools

Health Effects	Causative organisms / agents	Predisposing factors to infection
1. Follicular dermatitis	*Pseudomonas aeruginosa*	- High number of micro-organisms - Long exposure or high temperatures
2. Skin, ear and eye infections	*Pseudomonas aeruginosa* *Ps cepacia* *Myobacterium marinum* Papilloma viruses *Acanthamoeba*	- Injury - Spa pool surrounds and materials - Skin lesions from recent trauma or immune deficiency
3. Skin irritation	Chloramines	- Inadequate dumping frequency - Low chlorine disinfectant levels
4. Respiratory infection	*Legionella, Pseudomonas* spp, Enterobacteriaceae, aerobic amoebae, adenovirus	- Aerosol dispersion of contaminated water - Poor disinfection - Immersion of the head - Pre-existing respiratory disease
5. Genito-urinary infection	*Pseudomonas* spp, Enterobacteriaceae, *Trichomonas*, yeasts and fungi	- Excessive exposure to spa water - Bather practices
6. Gastro-intestinal	*Giardia, Cryptosporidium,* Enterobacteriaceae – *Klebsiella, Yersinia*	- Ingestion of water - Faecal pollution of water
7. Heat stress (hyperthermia)	Excessive exposure	- High temperature, especially above 40° C - Long exposure time - Predisposition to stress, heart conditions

Acknowledgments

The Standard was developed by a working party comprising representatives from the following organisations:

> Environmental Health Australia (SA Division)

> Australian Institute of Swimming and Recreation Centre Mnagement (SA Division)

> Local Government Association of South Australia

> Swimming Pool and Spa Assocition of Australia (SA Division)

> South Australian Swimming Pool and Spa Industry

> SA Health, Health Protection Programs.

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1428.1 Design for access and mobility - General requirements for access - New building work.

AS 1657-1992 Fixed platforms, walkways, stairways and ladders - Design, construction and installation

1688 Part 2: Mechanical ventilation for acceptable indoor-air quality.

2610 Spa Pools

- 2610.1 Part 1: Public spas
- 2610.2 Part 2: Private spas

AS/NZS 3000:2007 Electrical installations (known as the Australian/New Zealand Wiring Rules)

3533.1 – 1997 Amusement rides and devices Part 1: Design and Construction

3633 Private Swimming Pools – Water Quality.

3666 Air Handling and water systems of buildings – Microbial control.

Appendix A

Waterslides

Introduction

This section has additional information that is specific to waterslides.

Waterslides consist of a specially designed flume on a supporting structure with a receiving waterslide pool (a swimming pool) at the base of the flume to break the fall of the waterslide user.

Provided that the waterslide structure, its operation, the supervision of users and water quality requirements are effectively maintained, waterslides can be a lot of fun to use.

This section sets out the design criteria, water quality requirements and the management and operation provisions for waterslides. It is also a useful guide for waterslide owners and operators and will assist them to comply with the provisions of the General Regulations and provide a facility that is of a high standard, safe, hygienic and enjoyable for the users.

Management

In addition to requirements set out in the General Regulations, the owner should ensure that sufficient attendants are present to supervise the operation of the facility. The minimum staff requirements for the operation of a waterslide are:

> The observer positioned at the top of each flume who is responsible for supervising riders entering the flume
> One observer positioned at the waterslide pool who is responsible for supervising riders discharging from the flume(s) and their subsequent emergence from the waterslide pool.

Each observer must have an unobstructed view of the full length of the flume or there should be a device installed which is capable of indicating to the attendant at the top of the flume that the flume is clear for the next user.

A communication system should be installed to allow attendants at the top and bottom of the waterslide to communicate with each other.

The method for fee charging should not encourage users to run or be rough or boisterous in their endeavours to maximise the number of rides.

Turnover rate and water replacement

Due to the high bather loads, a volume equivalent to the total volume of the waterslide pool must pass through the filter at least once every hour. In those facilities where the water turnover rate requirements vary, the waterslide must be provided with a separate filter.

The waterslide water should be returned to the filtration system by collecting 80% of the flow via the overflow gutters and skimmers and drawing the remaining 20% from below the waterslide pool water surface level via the return suction points.

The waterslide pool should be provided with an automatic make up water system capable of maintaining the correct operating level.

Design and construction criteria

Waterslides are to be designed to ensure maximum safety and be constructed of materials which are safe, durable, water resistant and easily cleaned and maintained.

The design and materials used are to be in accordance with proper structural engineering practices providing a sound durable structure which will safely sustain all loads throughout the life of the structure. The waterslide flume and associated pool surfaces should be inert, non-toxic, smooth and easily cleaned. Where covered flumes are used, suitable ventilation should be provided to ensure an adequate air supply to the users and to remove any airborne odours or contaminants.

All user contact surfaces should be assembled, arranged and finished to prevent bodily injury to the users.

During design the following points should be considered:

> The structure should be designed to prevent unauthorised access to the waterslide flume and structural supports
> The structure should be designed and constructed to be easily capable of withstanding maximum loadings, giving full consideration to queuing (refer AS 1657)
  - Walkways from the waterslide pool to the top of the flume should be wide enough to allow easy passage of two people with hand rails on both sides (refer AS 1428.1) and should constructed of a suitable material which is non-slip, and easily cleanable
> The starting point should be provided with:
  - handrails made of stainless steel or a similar durable material
  - a non-slip floor surface
  - a two metre long safety canopy, or a suitable control device to regulate entrance into the flume
> Water slides should maintain the speed of the rider sufficiently such that at any possible attainable speed, the rider should be retained within the slide
> The ratio of height and length of a slide should be such that speed is controlled to a level appropriate to the radius of the turns and the size and depth of the receiving pool
> Sharp turns and curves in quick succession, especially in conjunction with accelerator drops, should be avoided.
> The joints and flume edges should be designed to prevent water leakage and bodily injury, in particular to fingers, hands and feet
> The invert of the flume should terminate at a depth of 150mm below or 100mm above the waterslide pool water surface
> High speed waterslides require additional care in the design of the flume exit, waterslide pool depth and width to ensure users can safely discharge into the waterslide pool
> The waterslide pool water depth at the end of the flume should be maintained between 900mm to 1 metre whilst the slide is in use. This depth is to be extended out in front of the flume for a distance of at least three (3) metres
> The internal surfaces of the walls and floors of the waterslide pool should be finished with a durable non-toxic material having a smooth finish and be of such colour to enable visual observation of any person in the waterslide pool at all times whilst the waterslide is in use
> The junctions formed at the intersection of the walls and floor of the waterslide pool should be provided with a coving rounded to a radius not less than 150mm nor greater than 300mm
> Water flow is to be towards the suction outlets located so that the water flow carries the waterslide user away from the flume and towards the exit at the far end of the waterslide pool
> The waterslide pool surrounds should be at least 1.2 metres wide and be constructed of a material that is light coloured, impervious, has a non-slip surface and formed to grade away from the waterslide pool to an approved drainage system
> The waterslide pool edges should be rounded so as to minimise injury but still enable them to be used as a hand hold for pool users. The upper surfaces of the waterslide pool edge should be on non-slip material in order to reduce the fall hazard and to facilitate gripping by pool users.

General

Inspection of flume

The total length of the flume should be inspected daily prior to use to minimise injury to users as a consequence of faulty or damaged flumes. If the inspection reveals a faulty or damages flume, the waterslide should be closed until repairs are carried out.

Electrical wiring

All electrical wiring is to conform to the requirements of AS/NZS 3000 and any other relevant state legislation.

Lighting

Where waterslides are covered or located indoors, adequate lighting, suitable for use in a water environment, is to be provided.

When the waterslide is used at night adequate lighting is to be provided to all areas of the waterslide complex.

Bather warning notice

A sign displaying the following advice should be positioned in a prominent position at the entrance to the complex and the flume where it can be read by bathers intending to use the waterslide:

- Each rider is to immediately leave the waterslide pool on discharge from the flume
- Tandem riding is only permitted for adults who are accompanying small children on the waterslide
- No person is to cause, suffer or permit rough behaviour or harassment of other persons in the waterslide pool, on the flume, walkways or platforms
- Glass and sharp objects are not to be carried or used within the flume, waterslide pool and its surrounds or the walkways
- Waterslide users are not to wear any items such as jewellery, watches or spectacles which are likely to result in personal injury to the user, other users or cause damage to the waterslide
- Persons are not to use the waterslide in a manner which will cause bodily injury to other slide users
- Persons under the influence of alcohol or drugs are not permitted to use the waterslide
- Health authorities warn that it is considered UNSAFE to use a waterslide:
  - if you are pregnant
  - for persons with limb or back weakness/disability
  - for persons with heart ailments
  - for persons with any condition which could predispose them to further aggravation of their pre-existing condition or injury
- Non-compliance with these rules could result in the user being directed to leave the premises
- Management reserves the right to refuse entry to any person at all times, i.e. Where the person is under the influence of alcohol, drugs or any other reason considered to create a potential hazard for that user or other persons.

Appendix B

Hydrotherapy Pools

Introduction

This section has additional information that is specific to hydrotherapy pools.

Hydrotherapy pools vary from other swimming pools in that they have a higher operating temperature and increased disinfectant level. The higher disinfectant level is required to compensate for the accelerated loss of disinfecting agent due to the increased water temperature.

Hydrotherapy pools are used for a range of therapeutic purposes by persons recovering from injury or incapacity, by those who are immune-compromised, or have intellectual impairment and for exercise. To minimise potential health risks it is essential to ensure that the hydrotherapy pool is properly managed, operated and maintained.

This section sets out the approved methods of disinfection and treatment for hydrotherapy pool water.

Management

Where a hydrotherapy pool is available for use by the public the owner of the facility must ensure that the hydrotherapy pool is under the control and management of a person who is knowledgeable and competent in the operation and maintenance of hydrotherapy pool water. Whilst the facility is available for use by the public it is the responsibility of the owner and the hydrotherapy pool operator to ensure that the hydrotherapy pool water quality is maintained in accordance with the requirements of the General Regulations.

Owners of hydrotherapy pools covered by the General Regulations are responsible for ensuring that the hydrotherapy pool is correctly operated. Failure to do so could result in legal proceedings being implemented for non-compliance.

Where the operator of a hydrotherapy pool fails to maintain pool water quality as prescribed, the relevant authority may deem the operator not to be competent and require the owner to provide a person who is competent.

It is recommended that sufficiently trained staff be available to provide constant supervision of persons using the hydrotherapy pool and that special provisions be provided for persons with impairment or disability.

Turnover rate and water replacement

Hydrotherapy pools have a higher level of suspended matter than other swimming pools because of their high bather load, increased operating temperature and organic contaminant loading. To ensure disinfection efficacy, a volume equivalent to the total volume of the hydrotherapy pool must pass through the filter at least once every two hours. For heavily used hydrotherapy pools, such as those used for fitness exercising, the recommended pool water turnover rate is less than one hour. In those facilities where pool water turnover rate requirements vary, the hydrotherapy pool should be provided with a separate filter.

For hydrotherapy pools with heavy bather loads it is recommended that approximately 25% of the pool water be replaced on a weekly basis. This should prevent the level of organic matter in the pool water reaching levels which may interfere with the disinfection process.

Temperature and relative humidity

Hydrotherapy pool water should not be heated to above 38°C. An ideal range is 28-35°C.

Any thermostatic device controlling hydrotherapy pool water temperature should be capable of maintaining the temperature to within ±0.5°C of the set range. A high temperature alarm should be installed to inform users that the water temperature exceeds 38°C.

For user comfort the ambient air temperature of the hydrotherapy pool area should be no more than 10°C below the temperature of the hydrotherapy pool water.

The relative humidity level of the air in the hydrotherapy pool area should be controlled to be within the range of 50% to 75%. The level can be maintained in this range by a fan boosted supply of fresh air and extraction of humid air, or by air conditioning with dehumidification. Care should be taken that no excess draughts are created.

Use of hydrotherapy pools by vulnerable populations

Hydrotherapy pools containing warm water (28-35°C) are used by persons with a wide range of medical conditions for exercise.

Pool water can become contaminated with micro-organisms arising either from the user's bodies or from the environment. Overuse and lack of proper disinfection may allow the survival and multiplication of certain bacteria and viruses, and users may become infected with such organisms. Hydrotherapy pools should therefore be correctly maintained and disinfected with free chlorine at a minimum concentration of 2.0mg/L.

There are certain medical conditions in which hydrotherapy is contra-indicated (e.g. unstable cardiac conditions, acute infections and the presence of open wounds). The users and use of hydrotherapy pools should be subject to proper supervision.

With regard to human immunodeficiency virus (HIV), survival or transmission of HIV in pool water has not been documented. HIV is susceptible to commonly used disinfectants especially those which are chlorine-based. Therefore, if hydrotherapy pools are properly disinfected and their use supervised, then use by patients with HIV infection poses no measurable risk to others.

Appendix C

Public Spa Pools

Introduction

This section has additional information that is applicable to spa pools specifically.

Public spa pools can contain a much higher concentration of suspended matter than swimming pools because of their reduced capacity, higher bather load to water volume ratio, increased operating temperature, aeration of the water body and elevated organic contaminant loading. To ensure disinfection efficacy, an amount of water equivalent to the total volume of the spa must pass through the filter at least once in every thirty minutes. In those facilities with varying requirements for pool water turnover, the spa pool should be provided with a separate filter.

As prescribed in the General Regulations, the water in a public spa pool must be replaced at a rate of at least 20% every day during which it is open for use or the spa pool must be completely drained at least once in every week. A public spa pool must also be cleaned at least once in every week that it has been open for use.

Water temperature

Spa pool water should not be heated to above 40°C. An ideal range is 35-37°C.

Any thermostatic device controlling the spa pool water temperature should be capable of maintaining the temperature to within ±0.5°C of the set range. A high temperature alarm should be installed to inform the operator if the water temperature exceeds 40°C.

Potential health effects

Infection is usually associated with high levels of microorganisms in poorly maintained spa pools. The warm and aerated environment promotes growth of a range of harmful organisms such as those listed in table 9 (refer section 10).

Bather warning notice

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

DO NOT put your head under the water.

DO NOT use the spa while under the influence of drugs or alcohol.

DO NOT use the spa for more than 20 minutes at a time.

DO NOT allow children to use the spa unsupervised.

DO NOT swallow spa water.

DO NOT use the spa if you have an open wound, feel unwell or are pregnant.

For more information

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