STANDARD

FOR THE

Inspection and Maintenance of Swimming Pools and Spa Pools in South Australia

DEPARTMENT OF HUMAN SERVICES
(SOUTH AUSTRALIAN HEALTH COMMISSION)

Government
of South Australia

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Standard for the
Inspection and Maintenance of
Swimming Pools and Spa Pools
in South Australia

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FOREWORD

The Public and Environmental Health Act (Section 47 (2) *(j)*) provides for the prescribing of codes of practice as a guide to assist local councils in the administration of the Act. The Public and Environmental Health Regulations 1991 (Regulation 10) provides for a South Australian Health Commission Code of Practice "Standard for the Inspection and Maintenance of Swimming Pools and Spa Pools in South Australia to be such a guide in relation to the operation and maintenance of swimming pools and spa pools.

This code of practice has been prepared to assist relevant authorities, pool owners, pool operators and the pool industry to ensure that management standards are satisfactory for the intended use of the pool and comply with the requirements of the legislation at all times whilst the pool is available for use by the public.

It specifically deals with water quality management aspects such as circulation and filtration; automatic disinfection, pH analysis and control equipment; water testing procedures; water replacement and chemical balance of pool water. These issues are very important in ensuring that pools are maintained in a sanitary condition and do not give rise to a risk to health.

Other issues covered include the pool structure, pool surrounds and environs, amenities, ventilation, safety and chemical storage.

This code of practice includes a comprehensive inspection check list aimed to assist pool owners and pool operators in maintaining a facility that conforms with the Public and Environmental Health Regulations and enables patrons to relax and enjoy safe water recreation activities. Additionally the check list may provide a useful guide for authorised officers administering the provisions of the Public and Environmental Health Regulations.

This code of practice is intended as a guide. Non compliance with its provisions does not constitute a breach of the legislation. Should a local authority need to instigate legal proceedings against the owner of a swimming pool or spa pool, it will need to do so under the specific provisions of the regulations or the general provisions of the Act.

If a facility is in a state warranting the issue of a notice under the Act, eg Sections 15, 17 or 20, the authority can, if it so desired, incorporate appropriate provisions of this code within the notice. The requirements of such a notice must be consistent with the intent and provisions of the particular section of the Act under which it is issued.

The Regulations apply to swimming pools and spa pools available for public use. Regulation 3 details the facilities to which the provisions of this code of practice apply, defines a "spa pool" and a "swimming pool" and establishes when such pools are taken to be "available for public use".

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1. INTRODUCTION

This code of practice applies to swimming pools and spa pools as defined by the Public and Environmental Health Regulations.

In the past, swimming pools were of the fill and empty type with no disinfection and when the water became grossly polluted the pool was drained and refilled with fresh water. These pools were a potential source of illness to the pool users. It was not until the 1950's that suitable treatment regimes were introduced to improve the water quality in pools and make them safer to use.

Legal standards did not exist in South Australia for swimming pools until 1978 when the Health Act Regulations were amended to require minimum standards for pool construction, operation and water quality. With changes to the Health Act in 1991 the provisions relating to water quality for swimming pools were transferred to the Public and Environmental Health Act. Provisions for specific-use swimming pools and spa pools are included under this Act.

The Public and Environmental Health Regulations are structured to ensure that the water in a public swimming pool or spa pool is treated in a manner which will prevent illness and discomfort to the user. They also require that the facility be controlled and managed by a person competent and skilled in maintaining pool water quality in order to provide the users with a safe, clean and sparkling body of water in which to enjoy their water recreation.

Minimum standards for disinfection, chemical water balance, pool operation, maintenance and safety have been set under the Public and Environmental Health Regulations to prevent:

- spread of infection amongst bathers
- irritation from chemicals in incorrectly treated water
- inadequate pool water clarity
- accumulation of contaminants in pool water from bather load and pool environs
- fouling of the facility and its water treatment system, and
- improper bather practices.

The adverse health effects of a poorly operated swimming pool or spa pool are addressed in the South Australian Health Commission Code “Standard for the Operation of Swimming Pools and Spa Pools in South Australia” and the reader is referred to that code for further information.

To provide pool users with an environment that is safe, enjoyable and pleasant, swimming pools and spa pools should be correctly designed, constructed of suitable materials and be provided with equipment that enables them to be operated and maintained in a manner that protects the health, safety and well-being of the users.

This code of practice sets out the requirements that should be followed to ensure that the pool structure and the pool water are maintained in accordance with the legislative requirements.

All legislation, codes of practice, standards or guidelines referred to in this code of practice include amendments made from time to time, unless otherwise stated. The provisions of this code of practice do not derogate from the need to comply with other laws of the State.

2. DEFINITIONS

algae	plant life that grows in pool water in the presence of sunlight and carbon dioxide.
automatic analysis 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 the pool at any given period of time.
chlorine	hypochlorous acid/hypochlorite ion (irrespective of the mode of addition or formation).
chlorine gas	a heavy, green highly poisonous gas which is compressed into liquid form for use in pool water as a bactericide and algicide.
combined chlorine	chlorine that has combined with ammonia, ammonium compounds or organic matter containing nitrogen, to form chloramines.
diethyl-p-phenylene	a chemical reagent used in a Lovibond or similar colourimetric diamine" (DPD) comparator for testing pool water for free, combined and total chlorine.
disinfecting agent	a compound or substance which, when applied as instructed to swimming or spa pool water, kills harmful micro-organisms.
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.
free chlorine	chlorine that has not combined, but is free to kill bacteria and algae, and destroy organic pollutants introduced into the pool water.
knowledgeable person	one who is able to control, manage and operate a pool to ensure that the pool water complies with the requirements of the Public and Environmental Health Regulations.
lint strainer	a device provided to screen out lint and debris.
make up water	water used to replace lost pool water.
mg/L	milligram per litre.
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.
operator	the person who has control and management of the pool, is knowledgeable in its operation and is sufficiently competent to ensure that the pool complies with the requirements of the regulations.
owner	in relation to premises, includes an occupier of the premises.

pathogenic bacteria	disease causing micro-organisms.
phenol-red	an organic dye used to test the pH of pool water.
pool water inlet	the point where the treated water is returned to the pool from the treatment plant.
pool water outlet	the point where pool water is taken from the pool.
primary amoebic meningo-encephalitis	a rare fatal disease caused by the organism *Naegleria fowleri* which enters the body through the nose.
recirculating system	the system of pipes, pumps, filters and devices which enable water to be taken from the pool, subjected to treatment and then returned to the pool.
sand filter	a device utilising sand and gravel as the filter medium.
skimmer gutter	a drainage system provided to collect surface water flow from the 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	means a pool or other water-retaining structure designed for human use: (a) that is capable of holding more than 680 litres of water, *and* (b) that incorporates, or is connected to, equipment that is capable of heating any water contained in it and injecting air bubbles or water into it under pressure so as to cause general turbulence in the water.
stabilizer	a compound such as cyanuric acid which is added to pool water to reduce chlorine loss due to sunlight.
superchlorination	the addition of sufficient chlorine to pool water to raise the level of free chlorine to at least 10mg/L for the destruction of combined chlorine (chloramines), algae and other impurities.
swimming pool	includes any waterslide, wave pool, hydrotherapy pool or other similar structure designed for human use, other than: (a) a spa pool; *or* (b) a tidal pool or other similar structure where water flows in and out according to the operation of natural forces.
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 required to achieve complete exchange of the swimming pool water through the filter.
UV + H_2O_2	ultraviolet light plus hydrogen peroxide disinfection system.

3. CIRCULATION & FILTRATION

Prior to the introduction of the South Australian health legislation covering the management of pool water quality, no requirements existed for controlling circulation and filtration of pool water.

Nowadays pool water management is a very complex process and requires skilled operators to maintain the pool water at the high standards required by public health authorities. To achieve the necessary level of treatment, pool water must be hydraulically circulated through a system that produces water that is sparkling, clear, chemically balanced and disinfected to destroy pathogenic bacteria prior to its return to the pool.

Therefore, it is necessary to ensure that the system is designed, installed and operated in a manner which will effectively flush the pool water from all areas of the pool in order to prevent the accumulation of dirt, impurities and bacteria. The pool water must pass through the treatment process within the defined pool water turnover rate.

3.1 SYSTEM REQUIREMENTS

As indicated above, systems used for pool water management require many factors to be considered during the design stage to ensure that the installed system is capable of efficiently maintaining the required water quality characteristics at all times of operation. The system should be relatively simple to operate and maintain and should be sized in accordance with pool depth and potential maximum bather load.

Where the facility will be used by large numbers of children it is important to ensure that the system has the capacity to handle the very heavy organic loading derived from these young bathers. In the past, many systems have been undersized, resulting in the need for expensive upgrading as the patronage levels increase.

A flow rate meter should be incorporated within the design of the pool hydraulic system as it provides an excellent means of indicating system performance, pool water turnover rate and hydraulic flow problems, including deterioration of pump capacity and filter clogging.

3.2 FUNCTIONS OF THE CIRCULATION AND FILTRATION SYSTEM

The main function of the circulation and filtration system is the removal of suspended, colloidal and organic matter to render the pool water clear, bright, colourless and odourless.

It is important to ensure that the pool circulation and filtration system is designed to remove a considerable proportion of the water from the surface, as this section of the water body is often grossly polluted in comparison with the rest of the pool water. Floating pollution and contaminated surface water may be removed rapidly from a pool by maintaining a constant flow of surface water into the skimmer gutters or skimmer weirs.

3.3 WATER QUALITY FACTORS

Water quality depends on the capacity and efficiency of the treatment system, the number of bathers and the operator's skills.

3.4 WATER POLLUTION REMOVAL

Removal of pool water pollution depends on the rate at which polluted water is withdrawn from the pool via the outlets, the surface flow into the skimmer system and the efficiency of the pump and filter.

3.5 FILTRATION SYSTEM

The legislation requires a continuous circulation of pool water through the filters while the pool is in use. The ability of a filtration system to maintain clean pool water is dependent on the:

- filter capacity and filter medium
- strainer or lint filter and pipe size
- skimmer system
- number of inlets and outlets

- pool water turnover rate
- pump capacity
- size and shape of the pool
- bather load.

3.6 INLETS AND OUTLETS

The size, shape and use of a pool can have an effect on pool water flow. Therefore, the number and location of inlets and outlets should be designed to ensure adequate water flow throughout the pool.

Pump intakes must comply with the requirements set by the Building Code of Australia.

3.7 PUMPS

Pumps used in the circulation system need to be of a size which will ensure that under all operating conditions the pool water turnover rate as required by the Public and Environmental Health Regulations is met. In practice, this means that the pumping system must have sufficient capacity to achieve the required pool water turnover rate and be able to handle the static and reticulation system friction and pressures.

Reticulation system friction is created by the circulation of pool water through the pipelines, bends, valves, pumps, heaters, strainer or lint filter, pool water filters and associated back pressures as the filters become clogged prior to backwashing. Other factors affecting pump efficiency include slime and scale build up in the pipes and pump wear and tear.

3.8 FILTERS

Swimming pools and spa pools should be provided with a filtration system that ensures that the pool water passes through the filter at least once in every:

- 6 hours for a swimming pool
- 2 hours for a hydrotherapy pool and wading pool
- 1 hour for a waterslide
- 1/2 hour for a spa pool.

Ideally, for system efficiency, hydrotherapy pools, waterslides and spa pools should be provided with their own filters. Where a common filter system is provided, the turnover rate for each type of pool system needs to be in accordance with the requirements specified in the Public and Environmental Health Regulations.

Filters need to be backwashed or cleaned as often as is necessary to ensure that the pool water turnover rate complies with the Regulations.

The pool operator should maintain records of filter operation including the number of backwashes, depth of medium and its replacement. If, after a period of operation, a filter requires more frequent backwashing it is probable that the filter or the procedures by the operator require investigation or attention.

Filter medium efficiency may deteriorate more rapidly in heated pool water than in non-heated pool water and therefore, filter mediums may require more frequent maintenance.

4. AUTOMATIC DISINFECTION, pH ANALYSIS & CONTROL

All swimming pools and spa pools covered by the definition under Public and Environmental Health Regulation 3 are required to be provided with automatic equipment that continuously analyses and controls the pH and disinfectant levels whilst the pool is available for use by the public.

This equipment should display the results of the analysis and provide readings in a manner that will enable the owner to maintain a permanent record of the results. These readings must be made available to an authorised officer on request.

Whilst the legislation is not specific on how the readings from the analyser are to be recorded, it is preferred that they are recorded in a form that enables monitoring of the readings to be made throughout the period of time the pool is available for use by the public.

Equipment presently available provides a range of output devices such as digital or analog readouts and paper charts in strip or circular form. Where the output device does not have an automatic recording capability, the pool owner should ensure that readings are taken at least hourly and recorded into a log book indicating the date, time, pH level, and disinfectant level. Where the equipment does not record in mg/L the owner should ensure that both the output device reading and the converted value are recorded.

Where possible the automatic analysis and control equipment should be provided with security devices to prevent tampering or interference with the set values.

All automatic dosing and control equipment should be checked for reliability. The pool owner should ensure that the pH and disinfectant levels are manually tested as often as is necessary to confirm the reliability of the equipment's operation. The automatic equipment should be periodically calibrated in accordance with the manufacturer's recommendations.

Confirmation of test results obtained from the automatic analysis equipment provides the pool owner with formal records of pool performance for management purposes and can be useful in cases of alleged improper pool operation.

In the event of automatic analysis, control and recording system malfunction the owner will need to ensure that manual readings are taken and the appropriate adjustments are made so that the pool water is maintained within the permissible levels as required by the legislation. Results of manual readings should be recorded in the log book. Where the pool water quality cannot be maintained in accordance with the levels as required by the Public and Environmental Health Regulations the pool should not be used.

Manual operation of the system is only permitted as an interim measure pending repair of the system. Pool owners and or operators should consult with the relevant authority regarding manual operation.

Operation of a pool in a manner contrary to the provisions of the legislation is an offence and the owner is liable to prosecution for non-compliance. Likewise damages may be claimed by a user should infection or an injury occur as a result of improper pool operation.

5. WATER TESTING

Whilst the owner of a swimming pool or a spa pool is required to provide equipment that automatically analyses and controls the disinfectant and pH levels the legislation also requires that other pool water characteristics be maintained within determined levels. Where the automatic analysis and control equipment does not monitor the additional characteristics, the owner needs to provide the operator with manual test equipment to enable testing to be done as often as is necessary to ensure that the water quality is maintained within the prescribed values.

The following provisions provide information on the test equipment required and procedures to be followed when conducting a range of manual tests on the pool water.

5.1 TEST EQUIPMENT

Every pool complex needs to be provided with appropriate equipment to enable measurement of the:

- level of disinfectant
- pH level
- total alkalinity level
- stabilizer concentration, where used
- pool water temperature.

The test equipment must have a range of values that will permit adequate measurement of the pool water characteristics.

The use of ortho-tolidine in pool water test kits is not permitted as it is listed as a carcinogen.

5.2 TEST CHEMICALS

Only fresh test chemicals should be used and be stored in a cool dark place to preserve their shelf life.

5.3 SITES FOR SAMPLE COLLECTION

To ensure that test results are indicative of the true status of the water quality in a pool, water samples should be collected at a depth of 300 mm to 400 mm below the water surface level and as near as practicable to a water outlet.

To verify the efficiency of the water treatment plant, a comparison should be made with test samples taken from as near as practicable to a water *inlet* and test samples taken at the water *outlet* to ascertain bather load demands.

For large pools and pools with a non-rectangular configuration, samples should be collected from a location near an outlet and two other locations.

5.4 FREQUENCY OF TESTING

As previously mentioned there are a range of characteristics that need to be monitored to ensure compliance with the legislation and they include:

- disinfection (total and free for chlorine systems)
- pH
- alkalinity concentration
- water clarity
- stabilizer concentration (where used for chlorine systems)
- hydrogen peroxide concentration (UV + H_2O_2 systems only)
- water temperature.

Testing frequency will vary for individual characteristics; however, it should be carried out as often as is necessary to confirm compliance with the requirements of the legislation.

For critical characteristics such as disinfectant and pH values the results should be recorded hourly with the remainder at least daily and more frequently where the bather load is heavy.

5.5 RECORDING OF TEST RESULTS

All tests results need to be recorded in a permanent form and be available for inspection by an authorised officer. They should be recorded in a log book indicating date, time, characteristic tested, result of test, name of person carrying out the test and whether it was a manual test or a result obtained from the automatic analysis and control system.

Additional comments on the recording of test results are covered under Section 4 “Automatic Disinfection, pH Analysis and Control”.

5.6 TEST KITS AND TESTING PROCEDURES

Due to the range of test kits and test systems available it is not feasible in this code of practice to provide details of the various systems and procedures. Given that the Lovibond test equipment is widely used by the water recreation industry and testing authorities and that chlorine is the main disinfecting agent used, the following procedures outline the Lovibond 2000 equipment and describes in detail the various tests.

The Lovibond comparator method has been developed to determine various values by measurement of colour intensity against predetermined colour standards. It enables a large range of pool water characteristics to be measured including:

- free, total and combined chlorine concentration

- pH level
- cyanuric acid concentration
- hydrogen peroxide concentration
- alkalinity concentration.

5.6.1 Chlorine

The Lovibond equipment uses the DPD method developed by Dr. A.T. Palin as the method of testing for chlorine and other disinfectants. The reagents are provided in tablet form for maximum convenience and simplicity of use.

Free chlorine within the 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.

Chlorine test apparatus and chemicals

- 1 x Lovibond 2000 comparator
- 3 x chlorine comparator discs
  - 1 x 3/40A Range 0.1 - 1.0 mg/L
  - 1 x 3/40B Range 0.2 - 4.0 mg/L
  - 1 x 3/40H Range 1.0 - 10.0 mg/L
- 2 x 10 mL graduated glass tubes
- 2 x 4 mL graduated special glass tubes
- 1 x stirring rod.
- 1 x brush
- 1 x plastic beaker
- No. 1 and No. 3 DPD tablets.

TEST PROCEDURE

Where the free and total chlorine levels exceed 4.0 mg/L it is necessary to use a different procedure to the one used for measuring chlorine levels between 0.1 to 4.0 mg/L. The first description below covers chlorine levels from 0.1 to 4.0 mg/L whereas the second description describes the procedures for chlorine levels from 4.0 to 10.0 mg/L.

*To determine the **free and total chlorine levels** in pool water within the range 0.1 to 4.0 mg/L, the following procedures apply:*

1 insert either the 0.1 to 1.0 mg/L disc (3/40A) or the 0.2 to 4.0 mg/L disc (3/40B) into the comparator

2 using the plastic beaker collect a sample of pool water from 300 mm to 400 mm below the water level near an outlet (always sample from the same location)

3 rinse the two 10 mL tubes with the pool water to be tested

4 fill one 10 mL tube with pool water to the 10 mL mark and place it into the left hand compartment of the comparator

5 add 3 mL of pool water to the second 10 mL tube and then add a No. 1 DPD tablet

6 place the tube on a solid base and gently crush the tablet using the stirring rod

7 fill the tube to the 10 mL mark with pool water, place the cap on the tube and then gently shake the tube to dissolve the tablet (if a quick dissolving DPD tablet is used, fill the tube with pool water to the 10 mL mark, add a No. 1 DPD tablet, place the cap on the tube and then gently shake the tube to dissolve the tablet)

8 place the tube into the right hand compartment of the comparator

9 rotate the comparator disc to match the colours as observed through the centre viewfinder

10 immediately read the value from the bottom right hand opening

11 record this reading as free chlorine expressed in mg/L.

*To determine the **total chlorine level** in the pool water continue with the test as follows:*

12 remove the tube from the right hand compartment of the comparator and add a No.3 DPD tablet

13 dissolve the tablet by gently grinding it with the stirring rod

14 replace the tube in the right hand compartment of the comparator

15 wait for two minutes

16 take the reading, as described in 9 and 10 above for free chlorine, and record it as the total chlorine level expressed in mg/L.

Where the combined chlorine level is required, deduct the free chlorine reading from the total chlorine reading to obtain the combined chlorine level in mg/L.

*To determine the **free and total chlorine levels** in pool water within the range 4.0 to 10.0 mg/L, the following procedures apply:*

1 insert the 1.0 to 10.0 mg/L disc (3/40H) into the comparator

2 using the plastic beaker collect a sample of the pool water from 300 mm to 400 mm below the water level near an outlet (always sample from the same location)

3 select the two special 4 mL tubes and one 10 mL tube

4 rinse the three tubes with the pool water to be tested

5 add 4 mL of pool water to one of the special 4 mL tubes and then place this tube into the left hand compartment of the comparator

6 add 4 mL of pool water to the 10 mL tube and then add a DPD No. 1 tablet

7 dissolve the tablet

8 pour this 4 mL of solution into the second special 4 mL tube and then place the tube into the right hand compartment of the comparator

9 rotate the comparator disc to match the colours as observed through the centre viewfinder

10 immediately read the value from the top right hand opening

11 record this reading as free chlorine expressed in mg/L.

*To determine the **total chlorine level** in the pool water continue with the test as follows:*

12 pour the 4 mL of solution, from the tube in the right hand compartment of the comparator, back into the 10 mL tube and then add a No. 3 DPD tablet

13 dissolve the tablet by gently grinding it with a stirring rod

14 pour this 4 mL of solution back into the special 4 mL tube and replace the tube into the right hand compartment of the comparator

15 wait two minutes

16 take the reading as described in 9 and 10 above for free chlorine and record it as the total chlorine level expressed in mg/L.

Where the combined chlorine value is required, subtract the free chlorine reading from the total chlorine reading to obtain the combined chlorine level in mg/L.

If the total chlorine level exceeds the free chlorine level by more than 1 mg/L then action must be taken to decrease the organic loading in the pool water because a high organic load will inhibit disinfection. Superchlorination or water replacement will decrease the organic loading in pool water.

5.6.2 pH

The Lovibond equipment requires the use of phenol red tablets to determine the pH of pool water. Phenol red is an organic dye which is yellow at a pH of 6.8 and turns progressively deeper red in colour as the pH increases to 8.4. The apparatus, chemicals and procedure used are detailed below.

pH test apparatus and chemicals

- 1 x Lovibond 2000 comparator
- 1 x pH comparator disc 2/IJ
- 2 x 10 mL graduated glass tubes
- 1 x stirring rod
- 1 x brush
- 1 x plastic beaker
- phenol red tablets.

TEST PROCEDURE

*To determine the **pH level** in the pool water the following procedures apply:*

1 insert the pH disc (2/IJ) into the comparator

2 using the plastic beaker collect a sample of the pool water from 300 mm to 400 mm below the water level near an outlet (always sample from the same location)

3 rinse the two tubes with the pool water to be tested

4 fill one tube with pool water to the 10 mL mark and place it into the left hand compartmentof the comparator

5 fill the other tube with pool water to the 10 mL mark and add one phenol red tablet

6 place the cap on the tube and then dissolve the tablet by gently inverting the tube

7 once the tablet has dissolved place the tube into the right hand compartment of the comparator

8 rotate the comparator disc to match the colours as observed through the centre viewfinder

9 immediately read the value from the bottom right hand opening

10 record this reading as the pH value.

pH reagents in tablet form contain sodium thiosulphate to prevent chlorine interfering with the pH determination.

5.6.3 Cyanuric acid

The Lovibond equipment requires the use of a buffer, precipitating and indicator solutions to determine the cyanuric acid concentration in pool water. The apparatus, chemicals and procedure used are detailed below.

Cyanuric acid test apparatus and chemicals

- 1 x Lovibond 2000 comparator
- 1 x Lovibond disc 3/92. Range 20-80 mg/L
- 2 x 10 mL graduated glass tubes
- 1 x plastic beaker
- 1 x Nessler cylinder for measuring 50 mL samples
- 1 x stirring rod
- 1 x 2 mL pipette

- 1 x 5 mL pipette
- 1 x plastic funnel
- 1 x brush
- filter papers (11.0 cm No. 1, Whatman)
- buffer solution CNA-1
- precipitating solution CNA-2
- indicator solution CNA-3
- distilled water
- chlorine based bleaching agent.

TEST PROCEDURE

*To determine the **cyanuric acid concentration** in the pool water the following procedures apply:*

1 insert the cyanuric acid disc (3/92) into the comparator

2 using the plastic beaker collect a sample of the pool water from 300 mm to 400 mm below the water level near an outlet (always sample from the same location)

3 rinse the two tubes with distilled water

4 fill one tube to the 10 mL mark with distilled water and place it into the left hand compartment of the comparator

5 pipette 2 mL of the pool water sample into the 50 mL Nessler cylinder

6 add distilled water to the Nessler cylinder until the volume in the cylinder is 50 mL

7 add 0.5 mL of the buffer solution, CNA-1, and 0.5 mL of the precipitating solution, CNA-2, to the solution in the Nessler cylinder

8 mix thoroughly using the stirring rod

9 fold a Whatman No. 1 filter paper into half, then into quarters, open it up and place it into the funnel

10 filter the solution through the filter paper into the second 10 mL tube (use the first few drops to rinse the tube)

11 fill the tube to the 10 mL mark

12 add 0.2 mL of indicator solution, CNA-3, to the 10 mL tube and place the cap on it

13 mix by gently inverting the tube

14 once mixed, place the tube into the right hand compartment of the comparator

15 rotate the comparator disc to match the colours as observed through the centre viewfinder

16 immediately read the value from the bottom right hand opening

17 record the reading as the cyanuric acid concentration expressed in mg/L.

Where the cyanuric acid concentration is above 80 mg/L the following procedure needs to be followed to prepare the solution which is placed into the right hand compartment of the comparator.

1 pipette 2 mL of the pool water sample into the 50 mL Nessler cyclinder

2 add 6 mL of distilled water to the 50 mL Nessler cylinder

3 withdraw 6 mL of the mixed sample from the Nessler cylinder and discard

4 add distilled water to the Nessler cylinder until the volume in the cylinder is 50 mL

5 proceed as stated previously in **7** to 16 inclusive above to obtain a reading from the comparator

6 multiply the reading by 4 to obtain the cyanuric acid concentration

7 record the reading as the cyanuric acid concentration expressed in mg/L.

When the cyanuric acid concentration is below 20 mg/L the following procedure needs to be followed to prepare the solution which is placed into the right hand compartment of the comparator.

1 pipette 5 mL of the pool water sample into the 50 mL Nessler cylinder

2 add distilled water to the Nessler cylinder until the volume in the cylinder is 50 mL

3 proceed as stated previously in **7** to 16 inclusive, for the initial determination of the cyanuric acid concentration, to obtain a reading from the comparator

4 multiply the reading by 0.4 to obtain the cyanuric acid concentration

5 record the reading as the cyanuric acid concentration expressed in mg/L.

The glass tubes should be cleaned with a chlorine based bleaching agent after use.

5.6.4 Hydrogen peroxide

The Lovibond equipment requires the use of a potassium titanium oxalate reagent to determine the hydrogen peroxide concentration in pool water. The test is based on the reaction between hydrogen peroxide and a titanium (IV) salt in acid solution to produce a yellow pertitanic acid complex. The intensity of the yellow colour is proportional to the concentration of the hydrogen peroxide.

Hydrogen peroxide apparatus and chemicals

- 1 x Lovibond 2000 comparator
- 1 x hydrogen peroxide comparator disc, 29647-3, range 3-70 mg/L
- 2 x 10 mL graduated glass tubes
- 1 x stirring rod
- 1 x brush
- 1 x plastic beaker
- 1 x 1.0 mL pipette
- distilled water
- potassium titanium oxalate reagent.

TEST PROCEDURE

*To determine the **hydrogen peroxide concentration** in pool water the following procedures apply:*

1 insert the hydrogen peroxide disc (29647-3) into the comparator

2 using the plastic beaker collect a sample of the pool water from 300 mm to 400 mm below the water level near an outlet (always sample from the same location)

3 rinse the two tubes with the pool water to be tested

4 fill one tube with pool water to the 10 mL mark and place it into the left hand compartment of the comparator

5 fill the second tube with pool water to the 10 mL mark and then add 1.0 mL of the potassium titanium oxalate reagent

6 place the cap on the tube and then mix the solutions by gently inverting the tube

7 wait for two minutes and then place this tube into the right hand compartment of the comparator

8 rotate the comparator disc to match the colours as observed through the centre viewfinder

9 immediately read the value from the bottom right hand opening

10 record the reading as the hydrogen peroxide concentration expressed in mg/L.

This test procedure cannot be used for measuring hydrogen peroxide concentrations which are below 3mg/L.

Where the hydrogen peroxide concentration is above 70 mg/L the following procedure needs to be followed to prepare the solution which is placed into the right hand compartment of the comparator.

1 add 5 mL of pool water to a 10 mL tube, then fill this tube to the 10 mL mark by adding distilled water and finally add 1.0 mL of the potassium titanium oxalate reagent

2 proceed as stated previously in 6 to 9 inclusive above to obtain a reading from the comparator

3 multiply the reading by two to obtain the hydrogen peroxide concentration

4 record the reading as the hydrogen peroxide concentration expressed in mg/L.

Where the hydrogen peroxide concentration is above 100 mg/L the following procedure needs to be followed to prepare the solution which is placed into the right hand compartment of the comparator.

1 add 2 mL of pool water to a 10 mL tube, then fill this tube to the 10 mL mark by adding distilled water and finally add 1.0 mL of the potassium titanium oxalate reagent

2 proceed as stated previously in 6 to 9 inclusive, for the initial determination of the hydrogen peroxide concentration, to obtain a reading from the comparator

3 multiply the reading by five to obtain the hydrogen peroxide concentration

4 record the reading as the hydrogen peroxide concentration expressed in mg/L.

5.6.5 Total alkalinity

Lovibond equipment requires the use of alkalinity tablets to determine the total alkalinity of pool water. 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.

Total alkalinity test apparatus and chemicals

- 1 x graduated measuring cylinder with sealing cap
- 1 x plastic beaker
- alkalinity tablets – there are two types available:
  - *total alkalinity tablets* - formerly M/2 - available in bottle number 50532 - foil number 51532; Minikit AF413
  - *alkalinity "M" tablets* - available in bottle number 50153 - foil number 51130.

The test procedure to be followed is the same for each of the tablets used, however, the calculation of the total alkalinity is dependent on the tablets used.

TEST PROCEDURE

*To determine the **total alkalinity** of pool water the following procedures apply:*

1 using the plastic beaker collect a sample of the pool water from 300 mm to 400 mm below the water level near an outlet (always sample from the same location)

2 pour 100 mL of the pool water sample into the graduated measuring cylinder

3 add one alkalinity tablet to the cylinder and then place the sealing cap on the cylinder

4 dissolve the tablet by gently inverting the cylinder

5 repeat steps **3** and **4** above until the yellow colour in the sample water changes to a permanent bright pink colour

6 record the number of tablets used to achieve the permanent colour change

7 calculate the total alkalinity by following one of the methods outlined below and then record this value as the total alkalinity of the pool water in mg/L.

Where the *total alkalinity tablets*, bottle No. 50532 or foil No. 51532, are used:

- the total alkalinity is calculated by:
  multiplying the number of tablets used by 20 and then subtracting 10
  i.e. total alkalinity = No. tablets x 20 - 10.

Where the *alkalinity "M" tablets*, bottle No. 50153 or foil No. 51130, are used:

- the total alkalinity is calculated by:
  multiplying the number of tablets used by 40 and then subtracting 20
  i.e. total alkalinity = No. tablets x 40 - 20.

  ***NOTE**: Where the "total alkalinity tablets", bottle No. 50532 or foil No. 51532, are used, 50 mL of pool water may be used for the test rather than 100 mL. In this case the total alkalinity is calculated by multiplying the number of tablets used by 40 and then subtracting 20 (i.e. total alkalinity = No. tablets x 40 - 20).*
  Where the "alkalinity "M" tablets", bottle No. 50153 or foil No. 51130, are used, 200 mL of pool water may be used for the test rather then 100 mL. In this case the total alkalinity is calculated by multiplying the number of tablets used by 20 and then subtracting 10 (i.e. total alkalinity = No. tablets x 20 - 10).

5.6.6 Comments on testing procedures

- only use fresh reagents
- ensure that equipment is clean
- do not get reagents on your skin
- do not allow glass near the pool area
- never pour reagents back into the pool
- always rinse test tubes upon completion of the test except where the process requires use of the resultant solution for the next test eg. free chlorine and total chlorine
- wherever possible readings should be taken against natural light, but not in direct sunlight. Where the facility is located indoors and use of natural light is not possible then artificial lighting can be used if its intensity is adequate.

6. WATER REPLACEMENT

6.1 INTRODUCTION

High levels of acid, alkaline compounds or combined chlorine within pool water may result in irritation to the skin, eyes and mucous membranes. Nitrogen, ammonia, amines and other organic contaminants may adversely affect the chemical balance of pool water where concentrations of dissolved solids are in excess of 2000 mg/L for non salt chlorinated pools and in excess of 14000 mg/L for salt chlorinated pools.

The presence of these contaminants in large amounts within pool water will create a heavy disinfectant demand and therefore make it difficult to maintain the level of disinfectant as required by legislation for the various types of pools. High concentrations of dissolved solids will affect the pool water quality in several ways:

- reduce disinfection efficiency
- render it more difficult to maintain chemical balance
- provide for enhanced algal growth
- increase staining and scaling of pool surfaces and fittings
- impart a dull appearance to the water
- increase salty taste.

To reduce the concentration of dissolved solids, organic substances and other contaminants within the pool water it is necessary to either totally or partially empty the pool and refill it with fresh water.

6.2 SPA WATER REPLACEMENT

The high water temperature, turbulent water flow, heavy usage and high bather-to-water ratio found in spa pools contribute towards the excessive accumulation of organic contaminants such as urine, perspiration, skin fats and oils, nasal mucus, hair and other debris. This organic material reduces the effectiveness of spa disinfection by consuming disinfectant and promoting growth of undesirable micro-organisms. The accumulated organic loading can only be reduced by dumping the spa water and refilling the unit with fresh water. The fresh water must be treated to achieve the required water quality prior to use of the spa.

Under the Public and Environmental Health Regulations, spa pools must be drained, cleaned and refilled with fresh water at least once in every week.

Whenever a spa pool has been drained, the exposed pool surfaces need to be thoroughly scrubbed and cleaned to remove dirt, accumulated body fats, oils and algal growths. Use of a suitable cleanser that is compatible with the chemical treatment used in the spa may be required. Protective clothing and gloves should be worn during this process. Before refilling the spa pool, the filter should be backwashed or replaced if a cartridge filter is used.

6.3 BACKWASH WATER

Water drained from 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. The proper disposal of this water is of particular significance in those parts of the State where cases of Primary amoebic meningo-encephalitis may occur.

Filter backwash or pool water 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, common effluent drain or stormwater drainage system 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.

7. ALGAL CONTROL

Algae are microscopic plants of which two varieties of importance are found in pools; one variety which floats freely in the water and a more persistent variety which imbeds 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 are essential for algal growth.

Algae will harbour and foster bacterial growth and retard the action of some disinfectants such as chlorine. For pools disinfected with chlorine, algal growth is objectionable because it reacts with the chlorine to create odours, cause turbidity, discolour the water and produce slimes that can contribute to accidents in and around the pool. The presence of algae in pool water will also tend to clog filters, necessitating more frequent backwashing.

A heavy algal growth may increase the chlorine demand in 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 pool whilst the pool is not in use, by maintaining a free chlorine level in excess of 10 mg/L. Following this treatment the algae should brush off quite readily. If not, the dose should be repeated until all the algae is destroyed. The dead algae should be removed by physical means prior to the pool being made available for use.

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

Algae in pool water can also be controlled by the use of algicides. They act in two ways – one to prevent growth (algistatic) and the other to kill growths (algicidal). In most cases the amount required to kill a growth in four hours may be 3-8 times greater than the amount required to prevent a growth forming over a ten day period. Some algicides possess a high chlorine demand and therefore, if used in pools disinfected with chlorine, they may deplete the amount of free chlorine available for disinfection. Other algicides may cause severe frothing in the water and filters.

Porous surfaces or cracks in a pool make it difficult to control or eliminate algae as they may be protected by the "dead" water in the porous structure and will give rise to spontaneous growth should the disinfectant or algicide level in the water be lost.

It should be noted that certain strains of algae will build up a resistance to some organic algicides and that clear, "sparkling" water does not necessarily indicate that the pool is free from bacteria, viruses, amoebae or other disease-causing organisms. It may only indicate that the pool water contains an effective algicide and that the recirculation and filtration system is operating satisfactorily.

8. ROUTINE MAINTENANCE

Routine maintenance of a pool and its associated plant, equipment and environs must be undertaken as often as is necessary to ensure that pool users are presented with a hygienic, safe and efficiently operated facility. During routine maintenance it is important to check pool structure and equipment for defects. A careless approach to maintenance will result in degradation of the facility and pool water and will subsequently create greater difficulties and increased costs when corrective measures are implemented.

There are a large number of different types of pools and facilities available to the public and therefore the points stated in sections 8.1 and 8.2 below should not be viewed as being an exhaustive list but rather as an indication of the areas to be covered in any maintenance programme.

Each pool should have a maintenance programme specifically designed for that facility.

8.1 POOL, PLANT AND EQUIPMENT MAINTENANCE

To ensure that a pool and its plant and equipment are adequately maintained the following procedures should be carried out:

- ensure that all pool surfaces are in a clean and sound condition. There should not be any missing, cracked or broken tiles, delamination of surfaces or a build up of scale, algae, slime, hair, lint, residues or scum
- remove floating debris from the water
- keep skimmer gutters and gratings clean and remove algae, slime and scum marks caused by surface water substances
- check the pool water level and top up as necessary
- ensure that the circulation, chemical dosing and automatic monitoring systems are operating efficiently. Sensing probes and electrodes need to be maintained in a clean working condition
- determine whether automatic analysis equipment requires adjustment or recalibration by carrying out manual testing of the characteristics monitored by this equipment
- manually test the water quality characteristics not analysed by automatic analysis equipment to confirm that they meet the requirements set by the legislation
- check the water flow rate through the filters and backwash if necessary
- ensure that there are no leaks in any pipework, joints or pumps
- superchlorinate the pool, where chlorine is used as the disinfectant, as frequently as is necessary to maintain the chlorine residual as required by the legislation
- ensure that where an ultraviolet light plus hydrogen peroxide system is used to disinfect the pool water the ultraviolet lamps and associated water tubes are clean and operating efficiently. The meter recording hours of operation should be monitored to confirm that the life of the ultraviolet lamps has not expired
- ensure that all meters are operating correctly
- ensure that pool handrails, steps, ladders, diving boards and stands are in a safe and sound condition
- ensure that where ramp access and hydraulic lifts are provided, that they are maintained in a safe condition.

8.2 POOL ENVIRONS MAINTENANCE

Dirt, grass cuttings, litter and other debris found within the pool environs may enter the pool water and adversely effect the water treatment processes. Even though these contaminants can never be completely eradicated, they should be controlled in order to ensure that they do not effect the water quality. The following procedures should be carried out to minimize the impact on water quality:

- clean all paved areas daily, or more frequently during busy periods. The cleaning method may involve the use of a dry or wet process. Whatever the process used it should not result in the discharge of substances to the pool water
- provide adequate refuse receptacles and clean them daily to minimize the attraction of flies and vermin. The receptacles should be emptied as often as is necessary into one main holding bin which should be located well clear of the pool area and kept covered until the contents are removed for disposal
- maintain lawns, garden areas and the pool environs in general in a clean and tidy condition. Particular attention must be paid to the removal of grass cuttings, paper and other debris to reduce the chance of it ending up in the pool water
- maintain surface water drains so that they are free of blockages.

9. AMENITIES

9.1 TOILETS, SHOWERS AND CHANGE ROOMS

Toilet, shower and change room facilities should be provided for both sexes in accordance with the requirements under the Building Code of Australia. Provision for physically disabled persons should also be made. It should be noted that where the local council is of the opinion that premises have inadequate facilities for sanitation or personal hygiene, under Section 20 of the Public and Environmental Health Act, the council may require additional facilities to be provided.

The toilets, showers, change rooms and fixtures within should be kept in good repair and should be thoroughly cleansed and sanitized as often as is necessary to maintain them in a clean condition.

Patrons should be encouraged to shower prior to using the pool.

9.2 FOOD SERVICE

Where facilities are provided for the sale of food or drinks they should be located separate from the bathing areas. Patrons should be prevented from entering the pool or its immediate surrounds whilst consuming food or beverages.

The sale of commodities contained in glass should be discouraged and adequate refuse receptacles for the disposal of food wrapping, drink containers and food scraps should be provided.

The food service operation at any pool should comply with the requirements of the Food Act and Regulations.

10. GENERAL SECTION

10.1 BATHING LOAD

There are three reasons why overloading of pools should be avoided:

1. pollution entering the pool builds up beyond the capacity of the water treatment system to deal with the excessive load
2. it becomes uncomfortable and dangerous to swim

3. it is very difficult to observe if any bather is in difficulty.

For pools such as wading pools, which are typically small and shallow with a high surface to volume ratio, the bather load is usually high and therefore the water quality needs to be monitored closely. The organic load derived from the bathers together with the impinging sunlight can quickly lower the amount of free chlorine available in the pool water. Splashing in the pool also serves to increase the loss of chlorine.

It is essential that wading pools are adequately disinfected as they are used predominantly by young children who are very susceptible to infection. In order to do this it is recommended that wading pools have a maximum pool water turnover rate of two hours or less.

10.2 POOL WATER TEMPERATURE

To prevent stress to bathers the temperature of the pool water should be maintained at a level that will not cause an appreciable increase or decrease in the deep body temperature of users.

10.3 DEPTH MARKINGS

For the safety of users the depth of pools should be prominently and clearly indicated, in writing which is at least 100 mm in size, at:

- the minimum and maximum depths
- locations where there is a sharp change in the gradient of the pool floor
- intervals along the length of the pool; the frequency will depend upon the size and configuration of the pool
- positions where they can be easily seen from the water and the pool side.

Ladders need to be provided at the deep and shallow ends of the pool.

10.4 VENTILATION

Where a pool is enclosed, adequate ventilation needs to be provided for the comfort of the users and the removal of odours and fumes.

Where an air handling system is provided it should be installed, operated and maintained in accordance with the Australian Standards, AS 1668, Part 2 and AS 3666 or as required by the local authority.

10.5 SALT CHLORINATORS

Salt chlorinators should be sized in relation to pool capacity, bather load and chlorine demand and should be operated correctly so as to ensure compliance with the provisions of the Public and Environmental Health Regulations.

Salt chlorinators generate chlorine only whilst the pump is running, therefore continuous operation of the pool water treatment system is required in most cases.

Frequent maintenance of the chlorine generating electrodes is required to prevent fouling.

Due to the high sodium chloride level in the pool water it is necessary to ensure that all metal fittings are corrosion resistant.

Where the salt chlorinator is not able to satisfy the chlorine demand the pool water may need to be supplemented with chlorine from an alternate supply to ensure that the minimum free chlorine levels are maintained.

10.6 STORAGE AND HANDLING OF POOL WATER TREATMENT CHEMICALS

The storage and handling of pool water treatment chemicals should be in accordance with the provisions of the:

- Dangerous Substances Act
- Occupational, Safety Health and Welfare Act
- Controlled Substances Act.

10.6.1 Storage

All chemicals used in pool water treatment and maintenance at the facility should be stored:

- in a cool, dry and well-ventilated place
- out of the reach of unauthorized persons
- preferably in a locked room
- in their original containers
- at ground or near ground level to minimize the possibility of the chemicals being accidently dropped or spilled
- so that liquid chemicals are kept well away from and not stored on top of or above solid chemicals
- in a bunded area in order to contain any spills or leakages.

Pool water treatment chemicals should not be stored 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. For example:

- 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 may form a mixture that spontaneously bursts into flames and in some instances may explode.

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

10.6.2 Handling

All persons while handling pool chemicals should:

- wear appropriate clean protective clothing, eye protection and respirators to prevent the chemicals coming into contact with their skin, eyes or clothing and to avoid breathing any chemical dust or vapour
- handle the chemicals in accordance with the label instructions
- use a separate measure for each chemical. Each measure should be clean, dry and made from a suitable material
- wash their hands before and after handling the chemicals
- handle the chemicals in a manner to prevent spillage. The chemicals should be dispensed over a plastic polythene sheet so that any spillage can be easily removed for disposal. NEVER return spilled material to its container as it may have become contaminated with other chemicals and could be hazardous
- use caution
- always follow the manufacturer's mixing instructions when dispensing a chemical from its container into a mixing container or pool water. It is accepted practice when mixing chemicals with water to always add the chemical to water and not water to the chemical
- follow the manufacturer's instructions for disposing of empty chemical containers. Rinse water should not be discarded into a drainage system, stormwater drain or water course, unless approval for the discharge has been obtained from the relevant authority
- after dispensing any chemical, the container should be tightly sealed with its original closure. Do not interchange closures
- in the event of spilling a chemical onto a person, immediately wash away the chemical using plenty of water. A dousing shower should be provided for this purpose
- clean up chemical spills in accordance with the manufacturer's instructions.

10.6.3 Storage provisions for chlorine gas

Where chlorine gas is used for water treatment:

- the gas containers should be housed in a separate room completely isolated from the public area. The chlorine gas storage room should not be located below ground level and must be provided with an external entrance
- the means of egress from the chlorine gas storage room should be operable from inside the room and shall be properly secured at all times. The egress should be to the external air. Under no circumstances, should egress be into the pool area
- the chlorine gas storage room should be provided with a ventilation system designed specifically for storing chlorine gas containers. The room should be provided with an alarm system that warns the pool operator and staff of a chlorine gas leak. This alarm should be audible from within any part of the complex. Where the swimming pool facility is enclosed, a means of rapid exit should be provided for staff and patrons in the event of a chlorine gas leak
- there should be a notice attached to the entrance to the chlorine gas storage room with the words "**CHLORINE GAS - DANGER DO NOT ENTER**" in red capital letters not less than 75 mm in height on a white background
- an approved self-contained breathing apparatus designed for use in an atmosphere containing chlorine should be provided in accordance with the following:
- the self-contained breathing apparatus should be readily accessible in close proximity to the chlorine gas storage room. It should *not* be stored *in* the chlorine gas storage room
- a record of the purchase date, use, and contents gauge readings should be kept with the breathing apparatus
- the self-contained breathing apparatus should be maintained in a safe and operable condition at all times
- all operators should be trained in the use of the self-contained breathing apparatus
- an instruction and precautions card should be prominently displayed next to the self-contained breathing apparatus. This card should have, in red lettering on white background, the phone numbers of the emergency people to be contacted in the event of a chlorine gas leak
- the cylinders of chlorine gas should be chained or secured in a manner to prevent movement
- a valve wrench should be in place on the valve of each chlorine gas cylinder in use
- all chlorine cylinders not in use should have the valve protection hood in place.

10.7 DISPOSAL OF UNWANTED POOL CHEMICALS

Pool chemicals that are no longer required because there has been a change in pool water treatment, or where the "use-by" date has expired or the chemicals have deteriorated, should be disposed of in a manner required by the Waste Management Commission or the local authority.

10.8 FIRST AID

Most pool chemicals are harmful if they are swallowed, inhaled or come into contact with the skin or eyes. In addition, there are a number of potential causes of injury within a pool, the plant and storage rooms and their surrounding areas. Therefore, first aid kits suitable to meet the potential needs of both staff and pool patrons and complying with the relevant regulations should be available.

The operator of a pool facility should have a set of first aid instructions for each of the pool chemicals held at the establishment and reference should be made to them in the event of a chemical accident. A dousing shower and eye wash should be provided for staff members or pool patrons if chemicals are spilled or splashed.

As a general rule the following procedures should be adopted whenever first aid treatment is required:

- if pool chemicals are swallowed, do not induce vomiting unless the first aid instructions say otherwise. More information should be obtained by making immediate contact with the Poisons Information Centre or a doctor:

POISONS INFORMATION CENTRE
TELEPHONE: (08) 204 6117
OUTSIDE METROPOLITAN AREA (008) 18 2111

- if pool chemicals are splashed into the eyes, hold the eyes open, flush them with slow running water for at least 15 minutes and immediately seek medical attention
- a person affected by harmful gases or fumes should be moved quickly into the fresh air and medical attention sought immediately. Persons attempting to rescue a person overcome by harmful or toxic gases should ensure that the necessary protective equipment such as a self-contained breathing apparatus is used when entering the area filled with harmful gases or fumes
- if pool chemicals come into contact with the skin or clothing, remove any contaminated clothing and wash the skin thoroughly with slow running water or use the dousing shower to wash the chemical from the skin and clothing.

10.9 BOWEL INCONTINENCE IN SWIMMING POOLS AND SPA POOLS

Within the community there is a range of people with varying degrees of impairment which may include bowel incontinence. This impairment can create problems for swimming pool operators and spa pool operators, the impaired individuals themselves and other users of the facilities.

In some isolated incidents pool operators have precluded persons with bowel incontinence impairment from participating in water recreational activities enjoyed by many others of the community.

The Equal Opportunity Act makes it unlawful for a swimming pool or spa pool operator to prevent entry to a public swimming pool or spa pool of persons on the basis of sex, sexuality, marital status, pregnancy, race, impairment or age.

On the other hand, Regulation 9 of the Public and Environmental Health Act, 1987 provides that: “A person must not while in a swimming pool or spa pool that is available for public use, spit, spout water or release bodily material (other than any such material released through the ordinary course of being in the water); Penalty $500”.

However, where an incontinent person intends to use a public swimming pool or spa pool and is unable to prevent contamination of the pool water, their entry to the pool water ***may be prevented*** by the swimming pool or spa pool operator.

In dealing with situations regarding access to a public swimming pool or spa pool by persons with bowel incontinence it is necessary for all parties including the pool operator, the person with bowel incontinence, a parent, guardian or care provider, to ensure that other users of the swimming pool or spa pool are not disadvantaged in the advent of an incontinence discharge into the pool water. It is *not* possible however, to identify whether a person is incontinent or not by the type of physical, intellectual or mental health related disability they have.

Management practices for persons with incontinence

It is important for pool operators to discuss the management issues with the person arranging the attendance of persons with incontinence with a view to providing the best possible outcome for all parties.

Some management practices for consideration could include:

- toileting prior to entering the water
- periodical toileting during the period of time whilst at the pool
- undertaking water recreation activities prior to food consumption
- wearing of incontinence pads and water-proof undergarments under the bathing costume
- providing of specific time allocation when the pool is not subject to heavy loading
- exclusion of the public for certain periods
- setting aside a portion of the pool for persons with impairment
- provision of purpose-built facilities.

A similar specialised approach could be taken when dealing with other ambulant impaired persons wishing to enjoy the pleasures of water recreational activities.

Decontamination procedures for incontinence discharge

The following procedures should be adopted in the advent of an accidental or deliberate discharge of faecal material into the swimming pool or spa pool water:

- have all persons exit the pool water
- turn off the water circulation system
- remove as much of the solid faecal matter as possible by the use of a scoop or similar device. For liquid faeces, vacuum the affected area to waste
- super-disinfect the affected area by hand dosing
- turn the water circulation system back on
- do not allow persons back into the pool water for at least 15 minutes.

11. CHEMICAL BALANCE OF POOL WATER TO CONTROL SCALE

The formation of insoluble calcium carbonate in pool water leads to scale forming on the internal surfaces of the pool, in the pipework and filter system. This leads to a restricted flow through the pipes, reduced filtration efficiency and shorter filter runs.

In 1936, Professor Langelier published work dealing with the calcium carbonate forming characteristics of water. He developed a formula known as the Langelier Index which can be used to predict whether pool water will either deposit or dissolve calcium carbonate. The formula lists five characteristics which effect the formation of calcium carbonate scale; they are pH, temperature, calcium hardness, total alkalinity and total dissolved solids.

The formula is:

LANGELIER INDEX = pH + TF + CF + AF - 12.1

where:

- the measured pH value is substituted directly into the formula
- the temperature, calcium hardness and total alkalinity are represented by the factors TF, CF and AF respectively as determined from table 1
- an average factor of -12.1 is included to represent the total dissolved solids.

*To determine the **scale forming or corrosive tendencies** of pool waterthe following procedures apply:*

1 measure the pool water pH, temperature in degrees Celcius, calcium hardness in mg/L and total alkalinity in mg/L

2 using the measured values for the temperature, calcium hardness and total alkalinity and table 1, convert them into the numerical values for the factors TF, CF and AF respectively.
Whenever the measured values do not correspond to the numbers listed in table 1, the values should be rounded to the nearest number listed in the left hand column for that characteristic.

3 add the pH value to the numerical values for TF, CF, AF and then subtract 12.1 to obtain the Langelier Index.

A *negative* Langelier Index indicates that the pool water will tend to dissolve calcium carbonate and thus have the tendency to be corrosive. A *positive* Langelier Index indicates that the water will tend to deposit calcium carbonate and thus have scale forming tendencies. A Langelier Index of *zero* indicates that the water is chemically in balance and the water is neither corrosive nor likely to deposit scale; however, the Langelier Index is considered to be satisfactory if the value lies between -0.5 and +0.5.

An example calculation of the Langelier Index is given below:

- if the measured values for pH, temperature, calcium hardness and total alkalinity are 8.5, 29 ^{o} C, 800 mg/L and 400 mg/L respectively, then the values to be used in the Langelier Index formula are: pH= 8.5, TF = 0.7, CF = 2.5, AF = 2.6.
  The Langelier Index = 8.5 + 0.7 + 2.5 + 2.6 - 12.1
  = 14.3 - 12.1
  = +2.2

This value of +2.2 indicates that the pool water has a tendency to form scale. Corrective measures such as lowering the pH and total alkalinity are required to lower the Langelier Index to within the range $\pm$0.5 and thereby maintain the scale forming tendencies of the pool water within acceptable limits.

TABLE 1: NUMERICAL VALUES FOR USE IN THE LANGELIER INDEX FORMULA

TEMPERATURE		CALCIUM HARDNESS		TOTAL ALKALINITY	
numerical measured value ^{o}C	numerical value to be used in the formula ***TF***	measured value ***mg/L***	numerical value to be used in the formula ***CF***	measured value ***mg/L***	numerical value to be used in the formula ***AF***
0	0.0	5	0.3	5	0.7
3	0.1	25	1.0	25	1.4
8	0.2	50	1.3	50	1.7
12	0.3	75	1.5	75	1.9
16	0.4	100	1.6	100	2.0
19	0.5	150	1.8	150	2.2
24	0.6	200	1.9	200	2.3
29	0.7	300	2.1	300	2.5
34	0.8	400	2.2	400	2.6
40	0.9	800	2.5	800	2.9
53	1.0	1,000	2.6	1,000	3.0

Another method for determining whether pool water is chemically in balance is to use the Taylor Watergram as detailed in the Australian Standard AS 3633 "Private Swimming Pools - Water Quality".

12. INSPECTION CHECK LIST

The following check list is provided as a guide to assist local authorities and pool operators in the inspection of swimming and spa pool facilities. It should be noted that although the check list covers many of the areas to be monitored during an inspection it is not an exhaustive list and there may be other areas to be covered, especially for specific use pools.

INSPECTION CHECK LIST

	Areas to be checked:		***Check for:***
1.	**POOL STRUCTURE**	*surfaces - internal, external, coping and surrounds*	loose, damaged or missing tiles; cracks; leaks; delamination; scale build up; corrosion; algal deposits; stains; rust; faults in the grouting; sharp edges; cleanliness; drainage to appropriate location; slip resistance.
		control or expansion joints	loose jointing or gaps; leaks; rust; integrity of sealant.
		skimmer gutters and skimmer boxes	grating to be clear, free of debris, fixed, secure and in good condition; efficient operation; safety; sharp edges; obstructions; compliance with the requirements of the Building Code of Australia.
		inlets and outlets	effectiveness; obstructions; safety; compliance with the requirements of the Building Code of Australia.
		fixtures and equipment such as ramps, ladders, handrails, diving boards, hydraulic lifts	rust; safety; cleanliness; appropriateness of materials of construction eg. stainless steel for ladders; secure fixing; appropriate location.
		spa pool construction	compliance with the requirements of the Building Code of Australia.
2.	**PLANT EQUIPMENT AND CIRCULATION SYSTEM**	*balance tank*	water level control device eg. efficiency operation of ball valve and overflow.
		pipework	secure fixing; leaks; formation of scale; restrictions in water flow; correct colour coding; sealing of pipework penetrations.

pumps	efficient operation; leaking glands and connections; vibrations; suitable mounting.
valves	efficient operation; correct labelling; secure fixing; leaks; correct operation of non return valves.
water filters	cleanliness; condition of the medium; backwashing requirements.
flow gauge, meter	efficient operation; accuracy of readings.
heater	correct temperature settings; accuracy of temperature gauge; correct operation of fail safe devices and alarms.
backwashing	frequency; disposal of backwash water in accordance with requirements.
electrical	safety; secure fixing; leakage detectors; water proofing of connections, instruments etc; correct functioning of operating and warning lights.
lighting	safety; adequacy; correct operation; light failure.
ventilation	effective operation; required rate of air flow; maintenance; cleanliness of filters and record of filter changes.
chemical injection points	blockages; correct operation; safe and sound connections.
automatic controls	correct operation; frequency of calibration; cleanliness of sensing devices and whether they require replacement; system reliability; frequency of manual testing which is used to confirm sensing device readings.
maintenance log book	recording of electrode replacements; calibrations; backwashing frequency; pump maintenance, UV lamp replacements.
procedures manual	ready availability and listing of all functions required to be performed.

		floors	cleanliness; sound condition; non-slip surfaces.
		access walkways, ladders	secure fixing; safety; non-slip surfaces.
		access to plant room and equipment	safety; clear and unimpeded access.
		security	means of preventing unauthorized entry; tamper proofing of dosing equipment, meters, recording equipment and automatic controls.
		manual testing equipment	availability; cleanliness; suitability; "freshness" of test chemicals and correct storage.
3.	**WATER QUALITY**	*chlorine levels, pH, alkalinity level, cyanuric acid level, clarity, UV and hydrogen peroxide level*	frequency of readings and compliance with legislation; recording of readings in log book.
		testing procedures	frequency of readings.
		daily log book or chart recordings	availability and recording of all test readings; water replacement and break point chlorination frequency; pool water temperature recording.
		water temperature control	accuracy of gauges; temperature set points; operation of high temperature alarms.
4.	**CHANGE ROOMS AND ABLUTIONS**	*number of facilities*	compliance with the requirements of the Building Code of Australia or the relevant authority.
		cleanliness	the cleanliness and sanitary condition of the buildings, changing facilities, fixtures, fittings and receptacles.
		water closets and urinals	cleanliness; correct operation; cracks or breakages of the fixtures and fittings.
		showers	cleanliness of floors, wall surfaces and facilities; correct operation of shower heads and taps; absence of mould.
		floors	non-slip surfaces; correct drainage; cleanliness.
		hand basins	cleanliness; cracks or breakages; adequate supply of water.

		hand drying facilities	availability.
		ventilation	effectiveness; maintenance; cleanliness of filters and registers.
		lighting	adequacy; effectiveness.
		refuse receptacles	cleanliness; availability; frequency of emptying; availability of suitable receptacles for the containment of used baby napkins, sanitary napkins, incontinence pads, paper hand towels and other waste.
		facilities for the handicapped	compliance with the requirements as set by the relevant authority.
5.	**CHEMICAL STORAGE AND HANDLING**	*chlorine gas*	compliance with requirements; availability of protective clothing and self-contained breathing apparatus; presence of signs.
		carbon dioxide gas	security of fixing.
		bulk storage	correct installation of tanks and feed delivery lines; adequate ventilation; bunding.
		segregration and separation of chemicals.	appropriate storage of chemicals.
		safety	availability of emergency dousing shower and emergency eyewash; appropriate protective clothing and equipment; fire extinguishers; first aid kits.
		manual handling	availability of appropriate manual handling equipment.
		delivery	adequate access for the delivery of chemicals.
		storage facilities	safety; correct labelling or signage; adequacy.
		chemical feed lines	secure fixing, soundness of lines and connections.

13. ACKNOWLEDGEMENTS

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- Australian Institute of Environmental Health (S.A. Division)
- Australian Institute of Swimming and Recreation Centre Management (S.A. Division)
- Local Government Association of South Australia, Legal Services
- Swimming Pool and Spa Association of Australia (S.A. Division)
- South Australian Swimming Pool and Spa Industry
- South Australian Health Commission, Environmental Surveillance Section.

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14. REFERENCES

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