

**Contents**

- 1. Recreational Water Illnesses (RWIs)**
- 2. Infection Control**
- 3. User Hygiene**
- 4. Cleansing of Pool, Equipment and Pool Surroundings**
- 5. Pool Contamination**
- 6. Water Quality Management**
- 7. Air Quality Management**
- 8. Pool Safety**
- 9. Pool Maintenance**

**References**

**Appendix I – Instruction Sheet for Spa Pool Users**

**Appendix II – Health Precautions**

**Appendix III – Sample of Pool Maintenance Record Form**

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Issue Date: Aug 2008

Page 2 of 22

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### **Introduction**

Spa pools are becoming more and more popular in Hong Kong. The physical structure of spa pools, their high water and air temperature, as well as intensive use by customers, all favour the growth of various micro-organisms. Maintaining the water quality can be challenging.

This guideline is intended for operators of public spa pools. The objective is to set out standards for disinfection and chemical water balance in order to prevent the spread of recreational water illnesses.

## 1. Recreational Water Illnesses (RWIs) (1)

Pools, if poorly designed or operated, can be major public health hazards. It may cause disease outbreaks. These conditions are known as Recreational Water Illnesses (RWIs) which include the following:

### 1.1 Intestinal diseases

Gastroenteritis, typhoid fever, cryptosporidiosis and bacillary dysentery can occur if water is polluted.

### 1.2 Respiratory diseases

Colds, sinusitis and septic sore throat can spread in areas of close contact or improperly treated pool water.

### 1.3 Eye, ear, nose, throat, and skin infections

Both excessive use of water-treatment chemicals and presence of infective agents can cause irritation to mucous membranes and the latter contribute to eye, ear, nose, throat and skin infections. Close physical contact and the presence of fomites (such as towels) can spread athlete's foot, impetigo and dermatitis.

## 2. Infection Control

It is multi-pronged and involves the appropriate personnel (staffing and pool users or expertise), the appropriate measures being carried out (water quality, pool regulation and risk management), and the appropriate environment controls (ventilation control and load factor). The following paragraphs serve as guidelines for a hygienic and safe spa activity.

### 2.1 Decreasing Load Factor

The behavioral factors of pool users will directly affect the host defense for illness. They are the length of immersion time, the number of pool users at a given time and various actions of users such as splashing and immersing heads in the pool.

Whatever the chlorine level in the pool is, the count of gram positive cocci is directly proportional to the number of pool users. Water quality deteriorates with heavy pool user load. Microorganisms such as *Pseudomonas aeruginosa* will proliferate on the skin if the level of disinfectants is low.

## 2.2 Response to Infectious Diseases Outbreaks

Pools may be closed when there is potential high risk of transmission of infectious disease due to close human contact.

## 3. Spa Pool User Hygiene

### 3.1 Instruction for Pool Users

Pool operators should provide users with written instructions. Educate spa users about appropriate spa use. (refer to Appendix I)

### 3.2 Health Precautions

For pregnant women or users with any of the conditions listed in Appendix II, consultation with a physician before spa use is recommended. Pool operators should provide users with the list of precautions

## 4. Cleansing of Pool, Equipment and Pool Surroundings

The pool and the entire system should be cleaned periodically and systematically. A routine of cleaning procedure is recommended as follows:

### 4.1 Daily Cleansing Routine

- a. Clean the concourse and changing area with appropriate concentration level of disinfectant e.g. sodium hypochlorite (mixing one part of 5.25% bleach with 99 parts of water, providing 500 ppm available chlorine) (16), then rinse well with

plenty of water, finally mop it dry.

- b. Remove grease on water surface, hair and visible dirt (with the help of vacuum where necessary)
- c. Dry any collection of water puddles around the pool, especially at corners and sewage exhaust, to prevent the formation of breeding ground for mosquitoes and germs.
- e. If bathing costumes or towels are supplied to bathers, they should be sterilized after each use.
- f. Visual check for water clarity. (refer to Water Quality Guideline).

#### 4.2 Weekly Cleansing Routine

- a. Backwash of the filter routinely.
- b. Clean pool wall, pool floor, handrails and stairs to remove bad marks.
- c. Clean the shower room with cleansing powder to remove accumulated dirt and soap.
- d. Check tiles for any breaks.

#### 4.3 “When Necessary” Cleaning Routine – Super Chlorination

- 4.3.1 Super chlorination overnight is recommended when the amount of combined chlorine as reviewed from routine daily test is deviated from standard value. This is observed during heavy pool use or following any accidental spillage of fecal matter or vomitus.
- 4.3.2 Super chlorination of the pool every two to four weeks during regular usage is another alternative to keep the water quality at desirable level especially if the pool would not be emptied for thorough cleansing routinely.
- 4.3.3 Super chlorination is the addition of an extra dose of chlorine to pool, which brings the Free Available Chlorine level to 6.0ppm. This will restore the chlorine’s ability to control algae and bacteria.
- 4.3.4 After super chlorination, the pool can only be used until the chlorine residual drops below 3.0ppm.

#### 4.4 Draining and cleansing of pool

Because the size of spa pools precludes draining after client usage, proper management is required to maintain the proper balance of water conditioning and disinfection(3) Considering the practicability factor, it might be justifiable to drain less frequently for large size pools, which have comparatively lower contamination load, than the smaller ones. Generally, it is practicable that draining and thorough cleansing of the pools is applied at least several times per year.

### 5 Pool Contamination

#### 5.1 Faeces in Pool

5.1.1 The procedure depends on whether the stool is formed and can be removed intact. Close pool, remove stool, hyperchlorinate to raise the residual chlorine level to not less than 2 ppm for at least one hour with pH between 7.2-7.8. If a loose stool is dispersed in the pool, the pool should be drained of water, hosed down, refilled and hyperchlorinated. After hyperchlorination, the pool can only be used until the chlorine residual drops below 3.0ppm. (15). Wait for one completed turnover of the filtration system before the pool is reopened for use.(4)

5.1.2 However, it is always difficult to differentiate between formed or loose stool in water. Therefore a more stringent measure should be taken, i.e. to treat it as loose stool, whenever in doubt.

#### 5.2 Blood or Vomitus

5.2.1 Germs (e.g. Hepatitis B virus or HIV) found in blood are spread when infected blood or certain body fluids get into the body and bloodstream (e.g. by sharing needles and by sexual contact). These germs are rarely transmitted to swimmers from a blood spill in a pool.

5.2.2 Germs likely to be spread by vomit are the noroviruses (Norwalk-like viruses). The following procedures are recommended for disinfection of the pool after blood or vomit contamination.

5.2.3 The pool should be temporarily cleared and the contamination dispersed until there is no further trace. Tests for disinfectant levels should be satisfactory before allowing people to use.

### 5.3 Handling Spills of Blood, Body Fluids, or other Potentially Infectious materials on the pool side

5.3.1 Other potentially infectious materials include human body fluids such as semen, vaginal secretions, cerebrospinal fluid, synovial fluid, pleural fluid, pericardial fluid, peritoneal fluid, amniotic fluid, saliva in dental procedures, any body fluid that is visibly contaminated with blood, and all body fluids in situations where it is difficult or impossible to differentiate between body fluids, such as mixing of faeces and blood; and any unfixed tissue or organ (other than intact skin) from a human (living or dead)

5.3.2 If spills occur, the surfaces should be decontaminated immediately with adequate staff protection. For recommendation of appropriate protection, please refer to section Personal Protective Equipment of Infection Control Guidelines, published by Centre of Health Protection (5).

5.3.3 Cleanse the visible blood spillage matter with disposable absorbent material. Mop the area with a cloth or paper towels wetted with one part of household bleach (5.25% hypochlorite solution) in 4 parts of water, leave for 10 minutes. Then rinse with water.

5.3.4 Small spill of blood can also be removed by applying chlorine-releasing powder directly to the spill. This can then be removed using one or more paper towels or wipes.

5.3.5 For spillage of other body fluids such as vomitus, cleanse the visible matter

with disposable absorbent material and then disinfect with one part of household bleach (5.25% hypochlorite solution) in 49 parts of water, leave for 15-30 minutes. Then rinse with water.

#### 5.4 Training & Education of Maintenance Staff and Pool

The staff should be aware of the importance of pool chlorination and certain of the correct procedures of monitoring test. If the chemical balance, the quality of filtration and circulation are not well maintained, the pool should be closed for investigation.

### 6. **Water Quality Management**

Pool operators should ensure that the pool has been maintained at a standard as stipulated. It is the responsibility of pool operators to familiarize themselves with the standards of water quality in accordance with the following requirements.

#### 6.1 Sanitizer

To disinfectant the pool water efficiently, sanitizer should be used. An ideal disinfectant should have two important distinct effects: a residual bactericidal effect and oxidation effect. Two types of sanitizers are commonly used. They are chlorine and ozone plus chlorine:

##### 6.1.1 Chlorine

Chlorine is a main disinfectant for the pool water. Its active bactericidal components are the Hypochlorous Acid (HOCL), and Hypochlorite Ion (OCL), the former being the stronger disinfectant.

Free Chlorine Level (FC) is the measure of both the HOCL & OCL levels and is pH dependent; the more alkaline the water is, the weaker the disinfectant. The minimum level allowed is never less than 1ppm and should be between 2-3 ppm. Combine Chlorine Level (CC) is the measurement of chloramines,

which is the combination of chlorine and nitrogen compounds in the pool. Chloramines will decrease the chlorine disinfecting power and it must be less than 1ppm. Total Chlorine Level (TC) is defined as  $TC = FC + CC$ . It is important to measure the FC, CC & pH levels of the pool, ensuring the disinfectant power of the sanitizer (6, 7, 8).

#### 6.1.2 Ozone

Ozone is mostly not used as the sole disinfectant in pool but is used in conjunction with chlorine or bromine. Where ozone is used with chlorine, a reduction of free chlorine is permitted provided mainstream ozonation is practiced and ozone is quenched, using a bed of activated carbon preventing ozone from degassing in the pool.

Where ozone is used with chlorine, the concentration shall be maintained as follows:

- (a) Free chlorine level: not less than 0.5ppm (18)
- (b) Ozone level: 0.4ppm after reaction tank and 0.0ppm before discharge to the pool.

### 6.2 Water Balance

To ensure the sanitizer acting effectively in water for disinfection while protecting the pool users from any adverse effect and maintaining the pool and equipment from the damage of corrosion or scale formation, the water chemical balance needs to be maintained at optimal level.

#### 6.2.1 pH- acid base balance

6.2.1.1 The ideal pH is 7.4 and the pool water should be kept with a pH value of 7.2 –7.8, pH level should be tested twice daily (7).

6.2.1.2 pH less than 7 or greater than 8 can cause eye irritation and itchy skin.

6.2.1.3 For sanitizer efficiency: as pH increases, free chlorine loses activity.

6.2.1.4 At pH 7.5, about 50% of free chlorine is available to kill germs.

### 6.2.2 Total Alkalinity

6.2.2.1 It is a measure of the number of alkaline ions present in the pool. The ions act as a shock absorber to prevent pH fluctuation. The bouncing pH level will increase the corrosion tendency and scaling potential.

6.2.2.2 The ideal range should be in the range of 100-250ppm (7).

6.2.2.3 The level should be tested when necessary, e.g. when water balance is disturbed.

### 6.2.3 Calcium Hardness

6.2.3.1 Too low or too high of calcium level in pool water will cause corrosion or scaling.

6.2.3.2 Calcium becomes insoluble at higher temperature.

6.2.3.3 The level in heated water should be 100-300ppm (7).

6.2.3.4 In Hong Kong, water is supplied and treated by water treatment works of Water Supplies Department. The treated water is soft in nature. The calcium level is intrinsically kept below 30ppm.

6.2.3.5 Calcium level should be tested when necessary, e.g. when water balance is disturbed.

## 6.3 Clarity

For effective disinfection, pool water must be clear. Particulate matters that cloud the water can shield micro-organisms from direct contact with the disinfectant. It should be removed by filtration.

### 6.3.1 Maintaining Clarity

Pool filters are not designed to remove bacteria, but to make the water in the pool clear. Clarity can be maintained by adjusting the maximum pool volume

turnover period. The maximum pool turnover period depends on pool design.

See the table as follows:

Pool Type	Turnover Period
Pool < 0.5m deep	$1\frac{1}{2}$ hr
Pools > 0.5m < 1m	1hr
Pools > 1.0m < 1.5m	$1\frac{1}{2}$ hrs

Routine and frequent backwash of the filter and cleansing of pump should be performed.

#### 6.3.2 Water clarity can be checked by the following methods

- a. Visual check of floor markings or other features on the pool bottom at its greatest depth. The markings should be clearly visible when viewed from side of pool.
- b. Check that the clarity of water in Nephelometric Turbidity Unit (NTU) and the color of water in Hazen Unit the standard of both parameters should not exceed 5.

#### 6.4 Water Temperature

The temperature of water in the pool can be maintained in the range of 35-37<sup>0</sup>C and should not exceed 40<sup>0</sup>C. (11) It should be checked twice daily.

#### 6.5 Microbiological Quality (7,10,11,12)

- 6.5.1 Water samples for microbiological test are performed as necessary such as after heavy contamination or part of epidemiological investigation.
- 6.5.2 If applied, pool water must meet the following bacteriological standards
  - a. *Escherichia coli* should be absent in pool water samples of 100ml each, taken at any time at any location in the pool.
  - b. The total bacterial count as determined by the 48-hour plate count method at 37<sup>0</sup>C does not exceed 200 bacteria per mL of pool water.

c. Testing for *Pseudomonas aeruginosa* or *Staphylococcus aureus*, which should be nil per 100ml pool water sample, is regarded as a more reliable indicator of defects in disinfection, especially when the above two tests (Total Colony Count and *E. coli* Tests) are failed (13)

6.5.3 For any significant findings, the pool should be closed immediately. Super chlorination (10 mg/L) of pool waters and its circulation through the entire system should be carried out. The pool should remain closed until further sampling demonstrates that the organism is no longer present.

6.5.4 Water sampling bottles should be supplied from the testing laboratory. They should be unbreakable and must contain a neutralizing agent for the disinfectant in use. To take the sample, the stopper or cap is first removed, making sure that nothing touches the inside of the bottle or cap. The bottle is then immersed neck downwards about 6 inches below the surface and turned immediately after removal from the water.

6.6 Cover spas, if possible, to minimize loss of disinfectant and reduce the levels of environmental contamination (e.g. debris and dirt)

6.7 Water testing methods and frequency

A test kit should be provided for analysis of chemical contents of pool water. The test kit should allow measurement of chlorine, pH, calcium hardness and total alkalinity levels.

6.7.1 Chlorine Concentration

Only the kits using the DPD (N,N-diethyl-p-phenylenediamine) colorimetric method to indicate free residual chlorine levels should be used. The OTO (orthotolidine) method of measuring chlorine concentrations must not be used (1), as OTO only measures the total chlorine level and is in itself carcinogenic. The free chlorine level in the pool water should be tested at least twice per day, increasing up to hourly when in heavy use.

6.7.2 pH Level

A colorimetric measurement method or a pH meter should be used and allow measurement of pH in intervals not greater than  $\pm 0.2$  pH unit of reference

range. The pH in the pool water should be tested at least twice per day, increasing up to hourly when in heavy use.

6.7.3 Total Alkalinity and Calcium Hardness

They should be measured by titration methods using appropriate indicators such as methyl orange, bromocresol green or bromophenyl blue. e.g. Pool and Spa Test Kit. Both tests are done when necessary, e.g. when water balance is disturbed.

6.7.4 Clarity

A visual check of pool water quality should be carried out at least once daily before the pool is open for use.

6.7.5 Water Temperature

The water temperature measurement should be carried out prior to the use of the pool on each working day.

6.7.6 Logbook

A logbook should be kept at the pool location, and must be produced for inspection upon request by any authorized officer. It should contain details of pool operations, including tests to be performed, results of all chemical and microbiological tests on pool water sample and water temperature. All logbook entries should be signed and dated. (Appendix IV)

### Summary of Water Standards and Testing Frequency

Pool standards	Parameter Range	Testing frequency
*Temperature (pool) °C.	35-37	Twice daily
*Temperature (room) °C.	22-28	Once daily
*Humidity (room) %	50-75	Once daily
**Free Chlorine ppm	1.0-3.0	Twice daily
**Combined Chlorine ppm	< 1	Twice daily
**pH	7.2-7.8	Twice daily
***Clarity	Floor markings on the pool bottom at its greatest depth can be clearly visible when looking from the side of the pool.	Once daily
Total Alkalinity ppm	100-250	As necessary
Calcium Hardness ppm	100-300	As necessary
**Total colony-forming units, /ml	<100	As necessary
**E- Coli, /100 ml	0	As necessary
Pseudomonas aeruginosa, /100ml	0	As necessary
Coliform organisms, /100ml	0	As necessary

Remark: The above standards are for pools disinfected with chlorine as main sanitizer

#### Reference

\* *Standard Australia AS 3979 Hydrotherapy pools, the Victorian Rehabilitation (1993)*

\*\**The Chartered Society of Physiotherapy Service standards, Management of the Hydrotherapy pool*

(2005)

\*\*\* *Public Spa Pools and Public Swimming, Division 3- Physical Parameters*

Remarks:

1. The above standards are for pools being disinfected by Chlorine as main sanitizer.
2. ppm is an abbreviation for *parts per million*. It is equivalent to *milligrams per litre* (mg/l).
3. The summary is also available at Appendix III.

N.B. Owing to various methods of pool disinfection, filtration and construction, individual operators can follow their pool manufacturer's label directions or maintenance authority advice for the pool parameters, provided that the pool water is safe and hygienic.

## 7. Air Quality Management

### 7.1 Ventilation

Ideal ventilation should be of 6 to 12 air changes per hour.

7.2 The ambient temperature of the pool area should be maintained at no more than 10°C below the temperature of the pool water. Air temperature from 22 to 28°C is suitable for pool users.

7.3 The relative humidity in the pool area should be maintained at a level as low as possible with the range from 50 to 75% (14)

7.4 Room temperature and relative humidity should be checked daily. The results should be recorded in a log book.

## 8. Pool Safety

- 8.1 Summoning aids or communication devices should be installed in the pool area, e.g. telephone, call bells, etc.
- 8.2 Training of staff in rescue procedures and regular pool rescue drills are recommended.
- 8.3 All hoists should be licensed and regularly checked by authorized bodies and should have preventive maintenance.
- 8.4 Ensure good visibility of submerged objects and avoid wet floor along poolside. Make sure all entry and exit are cleared from obstacles.
- 8.5 Prevent entrapment injuries with appropriate drain design and configuration
- 8.6 All incidents in pools / pool areas should be recorded in an incident logbook.

## 9. Pool Maintenance

Items no. 9.1-9.4 are to be constantly maintained by contractors as appropriate.

### 9.1 The Pool Backing System

Maintenance Work includes:

- a. Water heater system
- b. Water circulation system (pumping system)
- c. Water purification system (filter system)
- d. Electrical installation & hoist

### 9.2 Filter maintenance

Filter backwash should be done weekly or when triggered by a pressure drop (10).

### 9.3 Routine Check at Intervals

- a. Check circulating pump
- b. Check underwater light (if applicable)
- c. Check chemical pump (if applicable)
- d. Check chemical controller (if applicable)
- e. Check ozone system (if applicable)

Issue Date: Aug 2008

Page 17 of 22

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- f. Check filter working pressure (before backwash, after backwash)
- g. Check all cleaning equipment

#### 9.4 Annual Overhaul

Pools should be inspected thoroughly, after being emptied of pool water, of the tiles, grouting and fittings at least annually. Scales damaged grouting and stained tiles (results of poor pH control and impaired water balance) should be dealt with.

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Issue Date: Aug 2008

Page 19 of 22

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2007

## Appendix I

### **Instruction Sheet for Spa Pool Users**

#### ***Before your pool session***

1. Do not consume alcohol before your spa session
2. Do not overfeed or be too hungry before entering the pool.
3. Check if you have any skin rash, an irritation, a cut or a graze prior to entering the pool. These skin conditions may be predisposed to infections. Check if you are fit for spa use with your physician if necessary.

#### ***At the time of your pool session***

1. Care must be taken with wet floor.
2. Before entering the pool please:
  - go to toilet
  - take a shower
  - notify pool staff if you have any discomfort
3. Do not run around the pool concourse.
4. Do not jump or dive into the pool.
5. Use the handrail when climbing steps.

#### ***After the pool session***

1. Please take a shower after leaving the pool.
2. Please place used garment back on the assigned rack/ baskets.
3. Notify spa pool staff if you have any discomfort or any adverse reactions to your spa session

## Appendix II

### **Health Precautions**

If you have any of the conditions listed below, please consult your doctor whether you are fit for using spa pools.

1. Hypertension / Hypotension
2. Respiratory diseases, e.g. asthma, chronic pulmonary obstructive disease, tuberculosis, pneumonia\
3. Ischemic heart disease, vascular disease
4. Stroke
5. Infectious skin conditions, e.g. tinea pedis
6. Other skin conditions, e.g. rash, psoriasis, allergy
7. Epilepsy
8. Open wounds
9. Diabetes
10. Conjunctivitis, otitis
11. Pregnancy
12. Venereal diseases
13. Faecal or urinary incontinence
14. Urinary Tract Infections
15. Renal failure
16. Radiotherapy within recent 6 weeks
17. Fever
18. Dizziness
19. External fixators/ Drains in-situ / Catheters in-situ

Appendix III

**Sample of Pool Maintenance Record Form**

Date	Time	Room Temp °C	Relative Humidity %	Water Temp °C	Chorine content / ppm			pH level	Pool water clarity	By staff:
					Free	Combined	Total			