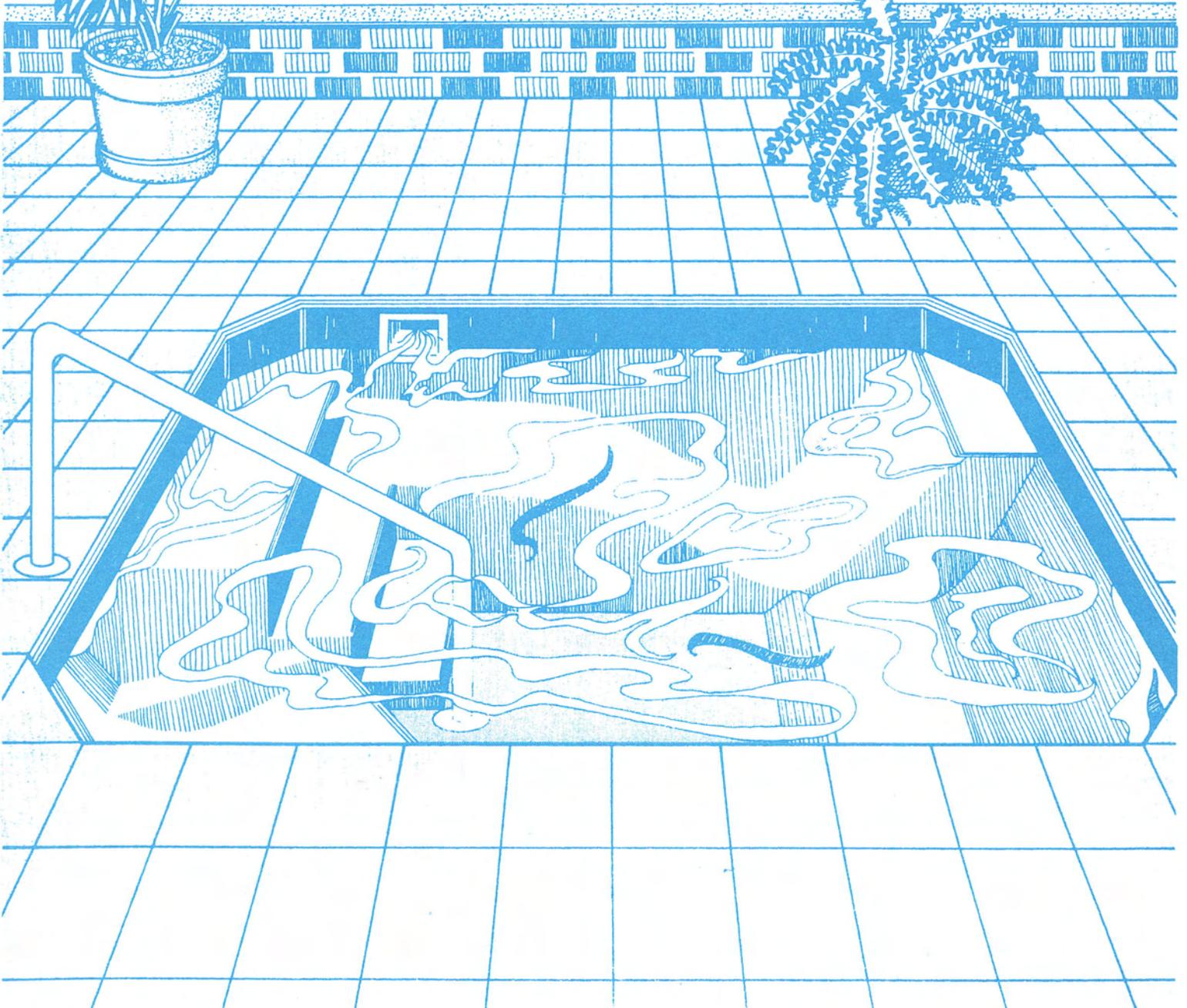
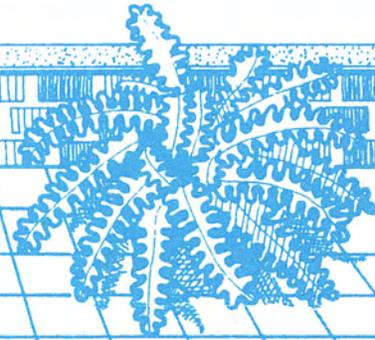


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# Suggested Health and Safety Guidelines for

# PUBLIC SPAS and HOT TUBS



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Only as a Reference  
for the Aquatics and Public Health  
Communities**

**The following manual was developed by CDC in 1981 and revised in January 1985. Much of the information in this manual may still be helpful to aquatics staff, designers, and public health professionals. However, the Healthy Swimming website is the most current information on water quality, disinfection, and operation guidance and should be consulted first at**

**<http://www.cdc.gov/healthyswimming>**

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# Suggested Health and Safety Guidelines for **PUBLIC SPAS** and **HOT TUBS**

**April 1981**  
**Revised January 1985**

**U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES**  
Public Health Service  
Centers for Disease Control  
Center for Environmental Health  
Atlanta, Georgia 30333

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## PREFACE

The spa and hot tub industry is currently expanding into States which do not have adequate regulations to control the health and safety features of these facilities. Epidemiologic evidence has shown that spas and hot tubs can be of significant public health concern if they are not properly designed, operated and maintained.

This publication has been prepared to assist State and local health agencies develop practical spa and hot tub safety and health regulations. These guidelines, along with the appropriate inspection and enforcement procedures, should serve as the foundation for the establishment of practical regulatory programs. Modifications to the technical content of the guidelines may be necessary to meet the particular needs of a State or local agency.

Readers are directed to the American National Standards Institute's (ANSI) standard for making buildings and facilities accessible to, and usable by, the physically handicapped. The reference standard is A117.1-1976 (1971) by the ANSI, 1430 Broadway, New York, New York 10018.

The preparation of this publication would not have been possible without the valuable advice provided by numerous individuals within many organizations. Special thanks are due to the National Spa and Pool Institute for preparing the initial draft of this document and for its liaison efforts with members of the spa and hot tub industry. Appreciation is extended to the following organizations for their review comments in the preparation of the first printing:

Swimming Pool Consensus Review Panel, American Public Health Association; Preventable Disease Division, Department of Health Services, State of Connecticut; Division of Personal Environmental Health Services, Department of Health, State of Ohio; Division of Communicable and Venereal Disease, Department of Health, The Commonwealth of Massachusetts; Division of Water Supply, Bureau of Environmental and Occupational Health, Department of Public Health, State of Michigan; and the Sanitary Engineering Section, Department of Health Services, State of California.

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## 1.0 INTRODUCTION

### 1.1 Objective

This document provides health and safety officials at the State and local levels preliminary guidelines for the evaluation and approval of the design, construction and operation of spas and hot tubs. It describes monitoring techniques and other procedures for ensuring safe operation.

These guidelines are meant to provide a basic view of these facilities from a health and safety standpoint. They are not meant to be used as a final standard for determining whether a public spa or hot tub is to be approved for construction or continued operation. These guidelines exclude facilities used or under the direct supervision and control of licensed medical personnel.

Because of the infinite variations in the installation and operational conditions of public spas and hot tubs, health and safety officials must look beyond these guidelines to uncover any special problems which may be unique to the particular facility being evaluated.

### 1.2 General Description—Public Spas and Hot Tubs

Spas and hot tubs are pools designed for recreational and therapeutic use and for physiological and psychological relaxation. These pools are not drained, cleaned and refilled after each use and may include, but are not limited to these types: hydrojet circulation, hot water, cold water, mineral baths, air induction systems or some combination of these.

Spas and hot tubs are shallow in depth and not meant for swimming or diving.

However, these facilities, like swimming pools, are closed cycle water systems and may be designed with complete water circulation, filtration, heating and, in some cases, disinfectant and overflow systems integrated with the water circulation system. In most cases, both spas and hot tubs equipped with heaters have automatic water temperature controls.

A public spa or hot tub, depending on its size, location and support equipment capacity, can accommodate from one to many bathers.

### 1.3 Health and Safety Problems Related to Public Spas and Hot Tubs

The primary health and safety problems experienced with public spas and hot tubs can be placed in three distinct categories:

- Drugs, alcohol and temperature
- Sanitation
- Injuries

#### 1.3.1 Drugs, Alcohol and Temperature

Most fatalities reported in the use of public spas and hot tubs have been attributed to the combination of high water temperature and the use of alcohol or drugs by the victims.

The deaths have inevitably resulted from drowning after the victim has fallen asleep in the hot tub or spa. These individuals were either alone or in the company of another person who had been drinking or had taken medication and was similarly affected.

The high temperatures of the spas or hot tubs in combination with even a moderate level of alcohol in the blood stream tend to accelerate drowsiness.

Consequently, careful monitoring of water temperatures and close supervision of patrons by the hot tub or spa operator as well as a strict prohibition against alcohol and drugs are fundamental for safety.

#### 1.3.2 Sanitation

Because of the inherent design and purpose of public hot tubs and spas, which feature high water turnover rates, high temperatures, and water agitation with a high bather load, safe disinfectant residuals and pH levels are quickly depleted during periods of use. If water conditions and quality are not properly maintained, serious health hazards could result.

Periodic checks (hourly testing or use of continuous reading devices) for safe disinfectant residuals during operation is mandatory for continued safety. Logs should be kept by the operator and vigilant independent checks should be made by local health authorities.

#### 1.3.3 Injuries

Injuries can occur when drain grates are broken or missing. For example, children playing around broken or missing grates may be drawn to the drain outlet and be unable to free themselves, or a person's long hair may become entangled in raised drain openings or suction jets. Therefore, broken or missing drain covers should be replaced immediately; children should be supervised and warned about playing around grates or other drain covers; and persons with long hair should wear it tightly pinned up or at least not allow it to flow loosely where drain covers are raised.

Safe exit from and entry to public spas and hot tubs are also areas of concern. Slips, trips and falls on wet interior and deck surfaces could result in injury. Consequently, proper deck materials, good drainage, handholds, and the safe design of exterior and interior steps and ladders to avoid slips and entrapment are important adjuncts to safety in any public spa and hot tub facility.

## 2.0 DESIGN AND CONSTRUCTION CRITERIA

### 2.1 Materials of Manufacture

**General.** The materials of components and accessories used in and around spas and hot tubs should be harmless to humans and compatible with the environment in which they are installed. These materials should fulfill the design, installation, and use requirements of the particular spa or hot tub for which they are intended. Spas and hot tubs may be constructed indoors or outdoors.

**Effects of Environment.** The materials for components and accessories to be used in and around spas and hot tubs should be such that the operational strength of the entire assembly will not be adversely affected by exposure to rain, snow, ice, sunlight, local normal temperature extremes, local normal wind variations, expected local air pollution products and the mechanical, electrical and chemical environment. "Local normal temperature extremes" and "local normal wind variations" are defined

as the average annual recorded limits of these measures for the past ten years at any installation point in the U.S.A. where such statistical information exists in "Statistical Abstract of the United States," U.S. Department of Commerce, Bureau of the Census, Section 6, Geography and Environment.

**Materials Selection.** All materials for components and accessories to be used in and around spas and hot tubs should be non-toxic and all parts with external surfaces and edges that may come in contact with the user should be assembled, arranged and/or finished (deburred, polished, etc.) so that they will not constitute a cutting, pinching, puncturing, or abrasion hazard under expected or casual contact.

**Toxicity and Chemical Compatibility.** The selection of materials for components and accessories to be used in and around spas and hot tubs should be such that the assembled and installed product will not be toxic to humans or harmful to the environment, and will be chemically compatible with the materials and environment contacted under intended use.

**Design Strength.** The strength of the assembled and installed components and accessories to be used in and around spas and hot tubs should be such that no structural failure of any part shall cause the failure of any other component part.

## 2.2 Structural Design

**Construction.** The structural design and materials used in spas and hot tubs should be in accordance with local building codes and with generally accepted good structural engineering practice. They should provide a sound, durable structure which will safely sustain the weights and pressures (dead load, live loads, liquid, hydrostatic and earth pressures) involved in each case. The spas and hot tubs should be watertight and surfaces should be inert, non-toxic, smooth and easily cleaned. Except for wooden tubs, where approved, spas and hot tubs should have light-colored interiors.

Roofs or canopies over spas or hot tubs should be constructed so that moisture or condensation from the roof or canopy will not drain into the spa or hot tub.

## 2.3 Dimensional Design

The maximum operational water depth should be 4'0" (1.2 m) measured from the waterline. Exceptions may be made for spas or hot tubs designed for a special purpose such as instruction, treatment or therapy.

The maximum depth of any seat or sitting bench should be 2'0" (61 cm) measured from the waterline.

A minimum height between the top of the spa/hot tub rim and the ceiling should be established. One State health agency requires a height of 7½'.

Spas and hot tubs should be provided with suitable handholds around their perimeter in areas where water depth exceeds 3'6" (1.1 m). Handholds should be no farther than 4'0" (1.2 m) apart and may consist of any one or a combination of the following:

- a. Coping, ledges, tub lips, radiused flanges, or decks along the immediate top edge should provide a suitable slip-resistant handhold located not over 12" (30 cm) above the waterline.
- b. Ladders, steps, or seat ledges.

- c. A rope or railing fastened to the wall not over 12" (30 cm) above the waterline.

The slope of the floor of the spa or hot tub should not exceed 1'0" (30 cm) of fall in 12'0" (3.7 m).

## 2.4 Steps, Recessed Steps, Ladders, and Recessed Treads

Steps, step-seats, ladders or recessed treads should be provided where spa and hot tub depths are greater than 24" (61 cm). Contrasting color bands or lines could be used to indicate breaks in the floor level of the hot tub or spa.

A spa or hot tub should be equipped with at least one handrail (or ladder equivalent) for each 50' (15.2 m) of perimeter, or portion thereof, to designate points of entry and exit, or with a deck designed to facilitate safe entry or exit.

**2.4.1** The design and construction of steps and recessed steps, when required, should conform to the following:

- a. Uniform step treads should have a minimum depth of 10" (25 cm) and a minimum width of 12" (30 cm).
- b. Riser heights should not be less than 7" (18 cm), nor greater than 12" (30 cm). When the bottom tread in a hot tub serves as a bench or seat, the bottom riser should be a maximum of 14" (36 cm) above the tub floor.
- c. The first and last risers need not be uniform in height with other risers but should comply with riser height requirements as noted above. The first (top) riser is measured from the finished deck or tub rim.
- d. Intermediate risers, those between the first and last risers, should be uniform in height.
- e. Step treads should have slip-resistant surfaces.
- f. Each set of steps should be provided with at least one handrail serving all treads.
- g. Handrails should be installed so that they can be removed only with tools.
- h. The leading edge of handrails facilitating exit should be located within 18" (45.7 cm) ± 3" (7.6 cm), measured horizontally, of the bottom riser.
- i. Steps may function as seats or benches.

**2.4.2** The design and construction of ladders, when required, should conform to the following:

- a. Ladders should be made entirely of corrosion-resistant materials.
- b. Ladder treads should have slip-resistant surfaces.
- c. Ladder designs should provide two handholds or handrails which fully serve all treads.
- d. The maximum outside diameter of handrails should be 1.9" (4.8 cm) and the minimum should be 1" (2.5 cm).
- e. There should be a clearance of not more than 6" (15.2 cm) nor less than 3" (7.6 cm) between any ladder and the wall of the tub or spa.

**2.4.3** The design and construction of recessed treads, when provided, should conform to the following:

- a. Step-holes at the centerline should have a uniform vertical spacing of 12" (30 cm) maximum and 7" (17.5 cm) minimum.
- b. Maximum vertical distance between the coping edge and

the uppermost recessed tread should be 12" (30 cm).

- c. Step-holes should have a minimum tread depth of 5" (13 cm) and a minimum width of 12" (30 cm).
- d. Step-hole treads should drain into the spa or hot tub to prevent the accumulation of dirt.
- e. Each set of recessed treads should be provided with two handrails which fully serve all treads.

## 2.5 Heater and Temperature Requirements

**2.5.1** Spa and hot tub gas heaters must be American Gas Association (AGA) design certified, display a rating data plate and AGA seal, and be certified as meeting the latest American National Standards Institute's (ANSI Z21.56) standard or other applicable and equivalent standards. Electric heaters for spas and hot tubs should be tested by a recognized agency and designed for the purpose intended. Current collectors having a separate ground shall be installed at each inlet and outlet of the electric heater.

**2.5.2** The maximum operating temperature of spa and hot tub water should never exceed 104°F (40°C). A thermostatic control for the water temperature which ensures that this limit will not be exceeded and is accessible only to the operator is essential. An in-line thermometer on the spa/hot tub water return line may be required.

**2.5.3** These maximum water temperature limits should be included in the operator's manual and user labels provided with each spa or hot tub by the manufacturer or installer. The labels should be posted in a prominent place on or in close proximity to the spa or hot tub itself.

## 2.6 Electrical Requirements

The latest National Electrical Code, as published by the National Fire Protection Association, should be used for the wiring and grounding of all electrical equipment associated with a spa or hot tub and the bonding and grounding of all metallic appurtenances. Electrical switches, outlets and equipment shall be at least 15' from the edge of the spa or hot tub and accessible only to the operator.

## 2.7 Inlets and Outlets

**2.7.1** An over-the-rim fill spout should have an air gap and be properly shielded so as not to create a hazard. The open end should have no sharp edges and should not protrude more than 2" (5.1 cm) beyond the edge of the spa or hot tub.

**2.7.2** The arrangement of water inlets and outlets should produce a uniform circulation of water so as to maintain a uniform disinfectant residual throughout the whirlpool or hot tub. The inlets for treated water should be flow-rate adjustable. State regulations should provide the criteria for inlet number and spacing.

**2.7.3** A means should be provided to completely drain the spa or hot tub and may include: bottom drains, a circulatory system, drain plug, etc.

**2.7.4** The total velocity through grate openings should not exceed 2' per second (61 cm/second). The open area in the

grates should be designed to prevent the entrapment of fingers, toes, etc.

**2.7.5** Outlets, except skimmers, on pump suction should be covered with suitable protective grates that cannot be removed without tools and that pose no safety hazard.

**2.7.6** Piping should be large enough to permit the rated flows for filtering and cleaning without exceeding the total head developed by the pump at the rated flow.

**2.7.7** The water velocity in spa or hot tub discharge piping should not exceed 10' per second (3.1 m/second). Suction water velocity in any piping should not exceed 6' per second (1.8 m/second).

**2.7.8** Piping subject to damage by freezing should be sloped for adequate drainage and supported at sufficiently close intervals so that sagging between supports will not trap water. Provisions should be made for expansion and contraction of pipes.

**2.7.9** Water outlets should be designed so that each pumping system in the spa or hot tub (filter system(s) or booster system(s) if so equipped) provides one of the following alternatives:

- a. Two outlets whose pipe diameter sizes are equal. (This may be two outlet drains or an outlet drain and a skimmer.) The system should be designed so that neither one of the two outlets is cut out of the suction line by a valve or other means.
- b. One antivortex drain. Antivortex drains should not provide a tripping or stubbing hazard.
- c. A 12" x 12" (30 cm x 30 cm) or larger square grate.
- d. Other approved means that guard against outlet entrapment.

## 2.8 Circulation Systems

**2.8.1** Spas and hot tubs should have circulation and filtration equipment as specified in these guidelines and as approved by the appropriate health agency.

**2.8.2** The equipment should provide a turnover rate for the entire water capacity at least once every 30 minutes and be capable of returning the water to a turbidity of 0.50 Nephelometric Turbidity Units (NTU's) at least once during the 4 hours following the peak bather use.

**2.8.3** Equipment should be designed and fabricated so that the water drains from the equipment, and can be drained from exposed face piping by removal of drain plugs and manipulating winter drain valves or other methods.

**2.8.4** Equipment furnished should be warranted by the manufacturer to be free from manufacturing defects in materials and workmanship.

**2.8.5** Equipment furnished should be provided with installation and operation instructions. These instructions should be readily available to the operator on the site.

**2.8.6** A flow meter should be provided on the effluent side of the filter system and a pressure gauge with an appropriate range should be provided on the influent and effluent side of all filters.

**2.8.7** Materials used in the circulation system should comply with appropriate requirements, such as the National Sanitation Foundation's (NSF's) Standard 50, *Circulation System Components for Swimming Pools, Spas or Hot Tubs*.

**2.8.8** In climates subject to freezing temperatures, the spa or hot tub shell and appurtenances, piping, filter system, pump and motor, and other components should be designed and constructed so as to be protected from damage due to freezing.

## **2.9 Overflow Systems**

**2.9.1** The overflow system should be designed and constructed so that the water level of the spa or hot tub is maintained at the operating level of the rim or weir device.

**2.9.2** When surface skimmers are used as the sole overflow system, one surface skimmer should be provided for each 100 square feet (30.5 m<sup>2</sup>) or fraction thereof of the spa or hot tub surface area. When two or more skimmers are used they should be located to maintain effective skimming action over the entire surface area of the spa or hot tub.

## **2.10 Filters**

### **2.10.1 Filter requirements — General**

- a. Filters should be designed to maintain water quality under anticipated operating conditions in accordance with these guidelines.
- b. Filters should be designed so that filtration surfaces can be inspected, serviced, and easily restored to the original design capacity.

**2.10.2** A means should be provided to permit release of air which enters the filter tank. This may be automatic or manual. Any filter and/or separation tank incorporating an automatic internal air release as its principal means of air release should have as a part of its design a means to provide a slow and safe release of pressure.

**2.10.3** All separation tanks should have a cautionary statement warning the user not to start up the filter pump without first opening the air release. The statement should be visible and noticeable within the area of the air release.

**2.10.4** Piping furnished with the filter should be of suitable material and capable, after installation, of withstanding three times the working pressure. The suction piping should not collapse when there is a complete shut-off of flow on the suction side of the pump.

**2.10.5** Filter components which require servicing should be accessible and available for inspection and repair.

**2.10.6** Filters should meet safety performance standards, such as NSF Standard 50.

## **2.11 Pumps and Strainers**

**2.11.1** The design and construction of the pump and component parts should provide safe operation and perform the functions for which they are intended.

**2.11.2** A pump and motor should be provided for circulation of the spa and hot tub water. Performance of all pumps should meet the conditions of flow required for filtering and for cleaning (if applicable) the filters.

**2.11.3** With all pressure filter systems, a suitable removable strainer or screen should be provided for all circulation pumps(s) to remove solids, debris, hair, lint, etc. Water entering the pump should pass through the screen.

**2.11.4** Units must be accessible for inspection and service. Replacement parts should fit with existing parts in the pump without the need for redrilling mounting holes or otherwise altering the replacement part of the pump.

**2.11.5** Where a mechanical seal is provided, components of the seal must be corrosion-resistant and capable of operating under conditions normally encountered in spa and hot tub operation.

**2.11.6** Proper direction of rotation for the pump should be clearly indicated on the pump.

**2.11.7** All motors should have as a minimum an open drip-proof enclosure (as defined by National Electrical Manufacturers Association's standards) and be constructed electrically and mechanically so they will perform satisfactorily and safely under the conditions normally encountered in spa and hot tub installations.

**2.11.8** Motors should be capable of operating the pump under full load with a voltage variation of at least 10 percent from nameplate rating. If the maximum service factor of the motor is exceeded (at full voltage), the manufacturer should indicate this on the pump curve. A pump data plate should be required on all pumps and positioned so that it is visible to the operator.

**2.11.9** All motors should have thermal overload protection or the equivalent, either built-in or in the line starter, to provide locked rotor and running protection.

**2.11.10** The motor frame must contain adequate provision for proper grounding.

## **2.12 Valves**

**2.12.1** When the pump is below the overflow rim of the spa or hot tub, valves should be installed on permanently connected suction and discharge lines and located in an accessible place outside the walls of the spa or hot tub.

**2.12.2** All valves should be located where they will be readily and easily accessible for maintenance and removal.

**2.12.3** Multiport valves should comply with a suitable standard, such as NSF Standard 50.

## **2.13 Air Induction Systems**

**2.13.1** An air induction system, when provided, must totally prevent water back-up that would cause electrical shock hazards.

**2.13.2** Air intake sources should be positioned and/or designed to minimize contamination (such as from deck water, dirt, etc.) of the spa or hot tub.

**2.13.3** Integral air passages shall be designed and tested at time of manufacture to provide structural integrity for a value of 1.5 times the indicated working pressure.

### **2.14 Disinfectant and Chemical Feeders**

**2.14.1** A means of disinfecting the spa or hot tub should be employed which provides a disinfectant residual in the water. Various methods/bactericidal agents are acceptable if they are registered by the U.S. Environmental Protection Agency and approved by the health department.

**2.14.2** Adequate and appropriate procedures for introducing a disinfectant into the recirculation system should be used. The means of introducing approved disinfecting agents should be sufficient to maintain the appropriate disinfectant residual. The DPD (diethyl-p-phenylenediamine) test or other suitable disinfectant test should be required for testing for the free residual disinfectant.

**2.14.3** Feeding equipment should be required and be capable of providing the required quantity of disinfecting agent into the spa water. The disinfecting material used should be subject to field testing procedures which are simple and accurate.

**2.14.4** Chemical feeding equipment should conform to a standard such as NSF Standard 50.

### **2.15 Sanitary Facilities**

Minimum sanitary facilities (toilets, showers, dressing rooms) shall be provided and maintained in accordance with recommended State and/or local sanitary requirements.

### **2.16 Ventilation**

Indoor spas, spa equipment rooms, bathhouses, dressing rooms, shower rooms, and toilet spaces should be ventilated adequately by natural or mechanical means, or a combination of both.

## **3.0 INSTALLATION CRITERIA**

### **3.1 Water Supply**

The water supply serving the spa or hot tub should meet the requirements of the appropriate local authorities.

### **3.2 Waste Water Disposal**

**3.2.1** Overflow water should be discharged to a waste system or returned to an approved filter system. Where perimeter overflow water discharges into a sewer, an air gap of at least two times the discharge diameter should be provided and located above possible flood or waste-water back-up level.

**3.2.2** Where an air gap cannot be provided in a practical manner, a relief manhole may be approved by the health agency. Where approved, the relief manhole should be constructed in the perimeter overflow main waste line with a grated cover, which should have a clear area twice the area of the main waste piping. The manhole should be established at a level such that the waste flow in the line will rise in the manhole and overflow at the surface of the ground not less than 2' (61 cm) below the level of the perimeter overflow lip.

**3.2.3** Backwash water should be discharged into a sanitary sewer through an approved air gap or to an approved sub-surface disposal system or by other means approved by the appropriate local authorities.

### **3.3 Decks**

Deck work should be designed and installed in accordance with approved engineering practices. This includes the design and quality of sub-base when required, concrete mix design, reinforcing, etc. In the absence of specific local engineering practices, the work may be performed in accordance with the recommended practices of the American Concrete Institute's Standard #302-69.

**3.3.1** Decks, ramps, and similar surfaces, including step treads and coping, should be slip-resistant and free of excessive standing water at all times.

**3.3.2** The roughness or irregularity of such surfaces should not cause injury or discomfort under intended use.

**3.3.3** Special features in or on decks such as depth markings, pool brand insignias or the similar should conform to the guidelines in this section.

**3.3.4** Risers for deck steps should be uniform and have a minimum height of 3-3/4" (9.5 cm) and maximum height of 7-3/4" (19.7 cm). Uniform step treads should have minimum unobstructed depth of 10" (25 cm).

**3.3.5** Earthen ramp areas should be adequately compacted to properly support the decks.

**3.3.6** A 4' (1.2 m) wide minimum continuous unobstructed deck, which may include the coping, should be provided around 50 percent or more of the spa or hot tub.

**3.3.7** The maximum slope of decks should be 1/2" per foot (4 cm per meter) except for ramps, which may vary according to their intended use. Such ramps should be approved by the appropriate health agency.

**3.3.8** The maximum horizontal clearance between adjoining concrete slabs and/or between concrete slabs and expansion joint material should be 3/16" (.48 cm) with a maximum difference in vertical elevation of 1/4" (.64 cm).

**3.3.9** Joints where coping meets concrete deck work should be watertight.

**3.3.10** Joints in decks should be provided to prevent cracks which may be hazardous due to changes in elevations, separation of surfaces, or movement of the slab.

**3.3.11** Areas where deck work joins concrete work other than that of the spa or hot tub should be protected by expansion joints filled with a non-rigid material such as mastic to adequately protect the spa or hot tub from the pressures of relative movements.

**3.3.12** Where deck work joins coping, the joining areas should be designed and installed so as to adequately protect coping and its mortar bed from damage as a result of normal movement of adjoining deck work.

**3.3.13** Decks should be edged, radiused or otherwise relieved so as to present no exposed sharp corners.

**3.3.14** Decks should be sloped to effectively drain water off to either perimeter areas or to deck drains. Drainage should remove spa and hot tub splash water, deck cleaning water, and rain water as quickly as it accumulates without leaving excessive puddles.

**3.3.15** Site drainage should be provided away from all deck work so as to direct all perimeter deck drainage, as well as general site drainage, away from such work. When required, yard drains should be installed to prevent the accumulation or puddling of site water in the general area of the deck work and related improvements. Gutters and downspouts should carry roof water away from spa and hot tub and deck areas.

**3.3.16** Piping, other than that integrally included in the manufacture of the spa or hot tub, should be pressure tested.

**3.3.17** There should be no valves installed in or under any deck work except for recirculation line valves. These may be placed in deck areas if a minimum 10" (25 cm) diameter access cover and shaft is provided to each such valve to facilitate servicing.

**3.3.18** Backwash sumps of the open pit or leaching design should be located so that they fall completely below adjacent deck work and fully outside of a line projected 45° downward and away from such deck work.

### 3.4 Deck Slope Recommendations

Slopes to provide proper drainage on poured or built-up decks may vary with the texture of the surface, but they should not exceed 1/2" per foot (4 cm per foot). Some recommended minimums are:

Smooth hand-finished concrete . . . . .	1/8" per foot
Exposed aggregate concrete . . . . .	1/4" per foot
Synthetic deck surface . . . . .	3/8" per foot

### 3.5 Equipment Room

An area approved by the health department should be used exclusively as an equipment room to house the pump, filter, heater, and support equipment. This area should include ample space for safely storing chemicals.

## 4.0 RECOMMENDATIONS FOR OPERATION

### 4.1 Operating Instructions

A detailed written manual for all phases of operation and normal maintenance of each component of the system should be available at each facility. The guide should be kept in a secure area and made available to each employee. This guide should include as a minimum the following information:

- Customer safety rules which should be posted at entrance to spa or hot tub.
- Required training or certification levels of operator employees.
- The number and type of operating personnel.
- Specific work statements for each employee.
- Spa or hot tub operation, maintenance and cleanup procedures.

- Proper water maintenance procedures.
- Chlorinator cylinder changing procedure (if applicable).
- Pump operating instructions.
- Backwash procedure.
- Operating instructions for vacuum filters (if applicable).
- Water test instructions—frequency of testing, method of test, test kit to be used, and interpretation of results.
  - Filter check procedure.
  - Recordkeeping for health department (operation report form).
  - First-aid report forms.
  - Emergency phone numbers.

## 4.2 Competence of Operators

The most important safety factor in the operation of public spas and hot tubs is the presence of trained and conscientious employees.

### 4.2.1 Operating Personnel

Personnel responsible for public spa and hot tub operation should be qualified in the operation of equipment, the procedure for performing the necessary water quality tests and safety checks, and the appropriate emergency procedures. At least one employee on duty during operating hours should have completed the Standard First-Aid and Personal Safety Course as offered by the American National Red Cross or an equivalent course and should be certified in cardiopulmonary resuscitation (CPR).

### 4.2.2 Responsibility for Disinfection and Water Treatment

A specific person on each shift should be made responsible for disinfection and water treatment operations. These people should be carefully trained in the performance of all routine operations as well as in emergency procedures and leak control procedures. If possible, these people should complete training courses given through local health departments. A typical reference text available for such training is "Pool/Spa Operators Handbook," published by the National Swimming Pool Foundation (NSPF). It is available from the NSPF, 10803 Gulfdale, Suite 300, San Antonio, Texas 78216. As an alternate, employees should be trained by a professional operator. The facility should not be in operation without such a trained employee present. Unauthorized persons should not attempt disinfection and water treatment operations.

### 4.2.3 Responsibility for Circulation and Filter System Operation

A specific person on each shift should be made responsible for circulation and filter system operation, checks, maintenance, backwash, makeup water, and cleaning. This person should be trained by a professional operator or expert in swimming pool operations and should carry out all scheduled cleanings and maintenance on the circulation and filter systems.

## 4.3 Refilling

Unlike swimming pools, spas and hot tubs must be emptied and cleaned frequently. The addition of daily makeup water and frequency of changing the water should be related directly to

water quality, to the length of time the spa/hot tub is in operation, and to the number of people using it. If the spa or hot tub is outdoors, possible dust and vegetation fallout could influence frequency of cleaning. Because of the high temperatures (up to 104°F, 40°C) at which spas and hot tubs are operated and because of the agitation and aeration of the water, excessive and rapid evaporation may also occur. The rate of evaporation is directly related to the length of time the aerator, the heater, and the filtration system are in operation. As the water evaporates, the concentration of dissolved solids rapidly increases in the water and eventually reaches the point where the water becomes cloudy and the chemicals begin to precipitate out of the water.

When this occurs, the spa or hot tub must be emptied, cleaned, and refilled with fresh water. Depending on the usage—number of bathers and the length of time the unit is in operation—water may be maintained for periods of 2 days to 1 month. The health department should be consulted.

#### 4.4 Signs

A caution sign should be mounted adjacent to the entrance to the spa or hot tub. It should contain the following warnings:

##### CAUTION

- Pregnant women; elderly persons; and persons suffering from heart disease, diabetes, or high or low blood pressure should not enter the spa/hot tub without prior medical consultation and permission from their doctor.
- Do not use the spa/hot tub while under the influence of alcohol, tranquilizers, or other drugs that cause drowsiness or that raise or lower blood pressure.
- Do not use at water temperatures greater than 104°F.
- Do not use alone.
- Unsupervised use by children is prohibited.
- Enter and exit slowly.
- Observe reasonable time limits (that is, 10-15 minutes), then leave the water and cool down before returning for another brief stay.
- Long exposure may result in nausea, dizziness, or fainting.
- Keep all breakable objects out of the area.

A sign should be posted in the immediate vicinity of the spa or hot tub stating the location of the nearest telephone and indicating that emergency telephone numbers are posted at that location. Those emergency telephone numbers should include the name and phone number of the nearest available police, fire and/or rescue unit, physician, ambulance service, and hospital.

A sign should also be posted requiring a shower for each user prior to entering the spa or hot tub and prohibiting oils, body lotion, and minerals in the water.

#### 4.5 Oils, Body Lotions, and Minerals

The use of oils, body lotions, and minerals should be prohibited.

#### 4.6 Personal Hygiene

Personal cleanliness of the users is important in preventing the introduction of dirt and infective material into the pool. A shower should be required before entering the spa or hot tub.

#### 4.7 Maintenance of Public Spa and Hot Tub Water

##### 4.7.1 Elements of Maintenance

Maintenance of clear, clean, odor-free water in spas and hot tubs depends on a daily program which achieves

- Proper physical operation
- Proper chemical balance
- Proper biological control.

##### 4.7.2 Physical Operation

Rapid turnover of water, proper skimming, and a clean, efficient filter are important physical requirements for proper water quality in spas and hot tubs.

Heavy use, turbulent and hot water, and increased concentrations of minerals and other solids make it imperative that spa and hot tub water be turned over quickly so that the filters may continuously remove insoluble debris from the water. Public spa and hot tub systems should be capable of minimum turnover rates of 30 minutes or less and daily filter cleanings (or cleaning schedules according to usage as specified by the filter manufacturer). (See Appendix.)

##### 4.7.3 Chemical Balance

Chemically balanced water depends primarily on the amount of acid or base in the water (pH) and on those chemicals which help maintain or stabilize the pH (total alkalinity) and scaling (calcium hardness).

Table 1 gives the range of pH and alkalinity for properly balanced water.

Test kits are available to make these measurements.

##### 4.7.4 Biological Control

High water temperature, the velocity and turbulence of the water, and heavy bather use all contribute to the organic contamination of spa/hot tub water.

An effective sanitizing chemical residual must be maintained in the spa/hot tub water at all times as shown in Table 1 and daily shock treatments (burn-out or oxidation of the organic materials in spa and hot tub water) should be employed.

In outdoor spa/hot tub installations the growth of algae may become a problem. A non-metallic, non-foaming, swimming pool algicide may be used as needed.

##### 4.7.5 Foaming

Foaming may occur when the spa or hot tub is first filled and operated or as the spa/hot tub water evaporates and the solids content becomes concentrated.

Anti-foaming agents are available to dissipate or prevent foam buildup and may be used on a regular basis if needed.

#### 4.8 Operational Parameters

The suggested operational parameters in Table 1 apply to indoor and outdoor spas/hot tubs and are based on current data and experience. As new information becomes available, certain recommendations may be modified. Spa/hot tub operators should consult with the local health department regarding specific operational parameters. Table 2 provides a quick and easy reference for operators of public spas and hot tubs.

#### 4.9 Use of Elemental Chlorine

Although not preferable from a safety standpoint, gaseous chlorine may be approved as a disinfectant. If gaseous chlorine is used as the disinfectant for a public spa or hot tub, however, the following procedures should be used.

##### 4.9.1 General

Chlorine gas has a characteristic odor and greenish yellow color and is about 2½ times as heavy as air. Chlorine is shipped in Department of Transportation specified steel cylinders; standard sizes contain either 100 or 150 pounds of chlorine. In the cylinder the chlorine has both a liquid and a gas phase. All cylinders are equipped with the Chlorine Institute Standard Chlorine Cylinder Valve.

Chlorine is a "hazardous material" subject to Department of Transportation and Environmental Protection Agency regulations. Users of chlorine must be informed as to the proper procedures for handling chlorine and as to appropriate emergency procedures. Detailed information is available from chlorine suppliers and the Chlorine Institute, 342 Madison Avenue, New York, New York 10017.

##### 4.9.2 Equipment and Installation

**4.9.2.1** Chlorination equipment should be located so that an equipment failure or malfunction will have minimum effect on evacuation of spa or hot tub users in an emergency.

**4.9.2.2** The chlorinator, cylinders of chlorine, and associated equipment should be housed in reasonably gas-tight and corrosion-resistant housing having a floor area adequate for the purpose. Provision should be made to securely fasten cylinders to a wall or post. Storage of any other chemicals in the chlorine enclosure should be forbidden except those used to check chlorine leaks.

**4.9.2.3** It is strongly recommended that enclosures be located at ground or above-ground level. If installation below grade is necessary, the enclosure should be provided with air-tight ducts from the bottom of the enclosure to atmosphere in an unrestricted area, a motor driven exhaust fan capable of producing at least one air change per minute and automatic louvers of good design near the top of the enclosure for admitting fresh air.

**4.9.2.4** Containers may be stored indoors or outdoors. Storage areas should: (a) protect against external corrosion, (b) be clean and free of trash and other chemicals, (c) not be near an elevator or ventilation system, (d) be away from elevated temperatures or heat sources. Full and empty cylinders should be segregated and appropriately tagged.

**4.9.2.5** Contents of a chlorine cylinder can be determined only by weight; therefore, facilities should include a scale suitable for weighing the cylinders. Cylinders should be changed only after weighing proves the contents of the cylinder to be exhausted.

**4.9.2.6** It is recommended that an automatic chlorine leak detector be installed. This is especially important in below-grade installations.

**4.9.2.7** Respirators approved by the National Institute for Occupational Safety and Health should be provided for protection against chlorine. It is recommended that at least one approved self-contained breathing apparatus be provided. Respiratory equipment should be mounted outside the chlorine storage enclosure.

**4.9.2.8** Elemental chlorine feeders should be activated by a booster pump using recirculated water supplied via the recirculation system. The booster pump should be interlocked to the filter pump to prevent feeding of chlorine when the recirculation pump is not running.

**4.9.2.9** Connections from the cylinders to the system depend on the type of chlorinator to be used and should comply with the chlorinator manufacturer's recommendation.

**4.9.2.10** Electrical switches for the control of artificial lighting and ventilation within the enclosure should be on the outside of the enclosure and adjacent to the door.

##### 4.9.3 Operational Procedures

**4.9.3.1** A specific person should be made responsible for chlorination operations and should be trained in the performance of routine operations as well as emergency procedures and leak control procedures.

**4.9.3.2** It is recommended that a safety wall chart be posted in or near the chlorine storage enclosure and a second chart in the pool office near the telephone. Such charts are available from many suppliers and from the Chlorine Institute, 342 Madison Avenue, New York, New York 10017. The telephone number of the chlorine supplier should be shown on this chart.

**4.9.3.3** Chlorine cylinders must be handled with care. Valve protection caps and valve outlet caps should be in place at all times except when the cylinder is connected for use. Cylinders must not be dropped and should be protected from falling objects. Cylinders should be used on a first-in, first-out basis. Fresh washers should be used each time a cylinder is connected.

**4.9.3.4** Chlorine Institute Emergency Kit A, which can be obtained from chlorine suppliers, contains devices for capping leaks at cylinder valves and some leaks which occur in the cylinder wall. Further information on these kits and training slides demonstrating their use are available from the Chlorine Institute.

**4.9.3.5** Although chlorine suppliers attempt to furnish chlorine in properly conditioned cylinders, chlorine gas leaks may still occur. Operating personnel should be informed about leak control procedures.

**4.9.3.6** As soon as a container is empty, the valve should be closed and the lines disconnected. The outlet cap should be applied promptly and the valve protection hood attached. The open end of the disconnected line should be plugged or capped promptly to keep atmospheric moisture out of the system.

**4.9.3.7** To find a chlorine gas leak, tie a cloth soaked in ammonia to the end of a stick and hold close to the suspected area. A white cloud will result if there is any chlorine leakage. Never use

water on a chlorine leak. The corrosive action of chlorine and water will make the leak worse.

## **5.0 RECOMMENDATIONS FOR MONITORING PUBLIC SPAS AND HOT TUBS**

### **5.1 General**

The routine inspection of public hot tubs and spas is basically an inventory of operation and maintenance procedures. The detection of structural and equipment defects which exist because of poor operation and maintenance are also important goals of this type of visit by the health authority.

The evaluation of water quality and general sanitation procedures practiced by the operator are of high importance.

Structural and operational changes caused by changes in normal patron use or operational character are also matters of concern in the routine inspection.

### **5.2 Inspection Policies**

#### **5.2.1 Frequency of Inspection**

One inspection every week during the operating season is essential for public spas and hot tubs until such time as health officials are satisfied that the operator is following proper sanitation procedures. At that point, a visit every two weeks as a minimum should be maintained. These suggested intervals are for the average public spa/hot tub and less frequent or more frequent inspection might be in order for some facilities at the discretion of the health official.

#### **5.2.2 Time of Inspection**

Inspections at times of least use and most use are as valuable in this field as they are in other fields of environmental health (e.g. restaurant inspection). Operational problems such as difficulty in maintaining disinfectant residuals and water clarity will necessitate review during high-use periods while problems of backwashing, structural soundness, and proper operation of support equipment might be helped by inspection during off-hours or when spas and hot tubs have been drained just prior to a refill.

#### **5.2.3 Inspection Routine**

The most efficient technique is one that will permit a thorough inspection in the least possible time by avoiding excessive retracing of steps. One suggested technique is to view the pool water and surroundings first, then proceed with an inspection of the support equipment and controls area, and finish with a review of the operator's records since the last inspection.

The spa/hot tub manager or operator should accompany the person making the inspection during the tour of the facility. This will increase the effectiveness of the inspection. If possible, inspection should be made after a heavy bather load day and just prior to the opening of the spa/hot tub on the next day.

### **5.3 Safety Checks**

The person making the inspection of public spas/hot tubs should check for the following during the inspection:

#### **5.3.1 Decks and Surroundings**

Decks should be checked for slippery areas and protrusions. Such items as standing water, growth of algae or fungi, drainage,

general cleanliness, sharp edges and protrusions, obstructions in the deck, inadequate handrails and areas of possible entanglement or entrapment of the bather's foot should be highlighted. The facility should be equipped with at least one exit with a handrail for each 50' of perimeter or portion thereof.

#### **5.3.2 Spa/Hot Tub Water**

Spa and hot tub water should be clear and have the proper disinfectant residual and pH. Standard test kits (e.g., DPD test for chlorine residual) can be used for these measurements. Maximum water temperatures should be checked by thermometer with the thermostatic controls operational. Turnover rates of 30 minutes or less under full flow operation should be checked as well as the proper operation of any automatic disinfectant feed equipment. Inspectors should look for the presence of oils, body lotions, and minerals not associated with chemicals used for water chemistry. Review of the operator's records on chemical balance should be made at this time.

#### **5.3.3 Spa/Hot Tub Shells**

**5.3.3.1** Spa/hot tub shells, including seats, steps, water outlets, deck copings and tub rims, should have no protrusions, extensions, means of entanglement, dangerous suction heads or other obstructions which can cause the bather to be trapped or injured.

All suction openings should have anti-vortex covers or grates which prevent flow velocities from exceeding 2' per second.

**5.3.3.2** Maximum water depth of 4' (1.2 m) and maximum depth of any seat or bathing bench of 2' (0.6 m) measured from the water line should be checked.

**5.3.3.3** A public spa/hot tub should have one or more suitable, slip-resistant handholds around the perimeter, located no farther than 4' apart.

**5.3.3.4** If surface skimmers are used, one surface skimmer should be provided for each 100 square feet (30.5 m<sup>2</sup>) of spa/hot tub surface area or fraction thereof.

**5.3.3.5** Spa and hot tub shells should be made of suitable materials as specified in Sections 2.1 and 2.2 of these guidelines.

#### **5.3.4 Spa/Hot Tub Equipment**

**5.3.4.1** Check certifications of gas-fired or electric heaters as well as pump and filter capacities and operational flow-rates.

**5.3.4.2** Electric switches, outlets, and equipment should be at least 15' (4.6 m) from edge of the spa/hot tub and water temperature controls should be accessible only to spa/hot tub operator.

**5.3.4.3** Agitation systems should be separate from the water treatment recirculation or heating system and connected to a 15-minute timer located out of the reach of a person in the spa or hot tub.

**5.3.4.4** Disinfectant feeders should be capable of supplying at least 20 ppm chlorine or the equivalent.

**5.3.4.5** Air induction systems, when provided, should prevent water backup that could cause electrical shocks. Air intake sources should not permit the introduction of toxic fumes or other contaminants.

**5.3.4.6** Spas and hot tubs of over 200 square feet of surface area should have provisions for vacuuming.

**5.3.4.7** All public spas and hot tubs should have air vent lines without valves between the atmosphere and all main drain lines. The air vent lines should be plumbed into the main drain lines near the main drain grates. The air vent lines should be the same diameter as the main drain lines.

### 5.3.5 Gas Chlorine Rooms

Problems with the gas chlorine storage room may be critical to the safety of public spa/hot tub users. It should be carefully checked on each inspection. Items to be checked include:

Proper ventilation; cleanliness; the storage of other chemicals, especially oxidizers in the room; proper operation and maintenance of the scale; location of electrical switches; proper warnings and emergency instructions in and just outside the door to the room; posted instructions on how to properly change chlorination cylinders; chlorine leaks as detected by ammonia at the cylinder valve packing, the head gasket seal between the chlorinator and the chlorine cylinder valve (chlorine leaking out the vent may be an indication of a leak at the safety shut-off valve); and, finally, the existence of proper gas masks on the premises and in an area least affected by the gas, if possible, so operators have ready access to them.

### 5.3.6 Warnings

A warning sign clearly readable by the user from the spa or hot tub should be posted. It should have the specific cautions spelled out in Section 4.4 of these guidelines.

### 5.4 Procedures for Monitoring Chemical Content

All tests for chemical content of spa and hot tub water should be carried out with standard test kits designed to test for that specific requirement (i.e., disinfectant residual, pH, alkalinity and cyanuric acid). Local health departments and local distributors of swimming pool equipment can give advice on proper test kits. Each kit is supplied with specific instructions and pass-fail criteria. However, the pass-fail criteria of precedence should be those spelled out in local sanitary codes or in Table 1 of these guidelines.

### 5.5 Procedures for Sampling Bacteriological Content

Local health and sanitation codes usually provide instructions on sampling techniques and safe water quality limitations for bacteriological content of swimming pool waters. These and the following general techniques may also be used for public spa and hot tub water:

#### 5.5.1 Sample Bottles

All sample bottles must be sterilized and treated with sodium thiosulfate to reduce the chlorine (or other halogen) present in the water at the time the sample is collected. If sodium thiosulfate were not used, the chlorine would be acting on the bacteria in the sample while it was being held or transported for testing.

#### 5.5.2 Collection of Samples

1. Time of collection — Samples should generally be collected only when the pool is in use and preferably during periods of heaviest use. The hour of the day and day of the week should be varied to obtain, over a period of time, a representative sampling of the sanitary quality of the pool. The frequency of sampling should be determined by the State and local health authorities.

2. Place of collection — The sampling point should be in the vicinity of groups of bathers and between return water inlets.

3. Technique of sampling — The first step in sampling is to carefully remove the cap and stopper from the bottle without touching the inner surfaces of the stopper. Hold the sterile bottle near its base and downward at a 45° angle. Fill in one slow sweep down through the water with the mouth of the bottle always ahead of the hand. Care should be taken to avoid contamination of the sample by floating debris. The stopper and cap are then replaced. The bottle must not be rinsed in the spa/hot tub or the sodium thiosulfate will be removed.

#### 5.5.3 Disposition of Sample

The sample should be taken to the laboratory as soon as possible for processing, preferably within 6-12 hours. The sample should be refrigerated immediately upon collection and held at less than 10°C if it is not immediately transported to the laboratory for assay. Pertinent data such as sampling time, location of sample, sampler's identification, and desired analysis should accompany the sample.

#### 5.5.4 Bacteriological Analysis of Spa/Hot Tub Waters

**5.5.4.1 Tests for Bacteriological Quality of Water.** The following tests should be conducted according to *Standard Methods For the Examination of Water and Waste-water* or equivalent.

1. Presence of the coliform group of organisms — Coliform organisms are easily tested for, and the test is sensitive. No appreciable quantity of fresh fecal material can be present in the water and escape detection when the coliform test is properly carried out.

2. Total numbers of bacteria by the standard plate count — This is a valuable measure of the quality of spa/hot tub water and when used with the coliform test gives important complementary information.

3. Any other tests deemed necessary by the health department.

**5.5.4.2 Interpretation of Test Results.** Authorities differ somewhat on details for standards for spa/hot tub waters. One State uses the following standard: "The presence of organisms of the coliform group, or a standard plate count of more than 200 bacteria per milliliter, or both, in 2 consecutive samples or in more than 10 percent of the samples in a series shall be deemed as unacceptable water quality."

#### 5.5.4.3 Causes of Bacterial Limit Violations

1. Spa/Hot Tub Area and Equipment

a. Structure of spa/hot tub — The lack of a smooth inner spa/hot tub surface contributes to the accumulation of foreign matter and growth of microorganisms.

- b. Disinfection — Inadequate disinfection devices, poor algae control, and easy contamination by foreign matter such as leaves and other organic matter may result in high bacterial counts.
- c. Water treatment equipment — Filtration equipment of inadequate design or size is a prime cause of poor water condition.

2. Bather control — Failure to require showers or limit the number of bathers may contribute to unsatisfactory bacterial levels. Some states require at least 10 square feet of surface area per bather.

3. Makeup water — Poor quality makeup water added to the spa/hot tub will obviously result in the contamination of otherwise satisfactory water.

4. Sampling procedure — Deviation from recommended sampling procedures could yield false results.

**5.5.4.4 Actions.** If the bacterial count is high in any test, proper disinfectant procedures should be reviewed with the operator and changes made to improve the situation. At the discretion of the health authority, the facility may be temporarily closed and decontaminated. Daily checks by the inspector will be necessary until the problem has been resolved.

## 6.0 RECOMMENDATIONS FOR IDENTIFYING AND TROUBLESHOOTING HEALTH AND SAFETY PROBLEMS DURING THE OPERATION OF PUBLIC SPAS AND HOT TUBS

The identification of the potential health and safety problems one may encounter with public spa/hot tub operation is detailed in Sections 4.0 and 5.0 above. Troubleshooting these problems in an attempt to find their cause may require:

- A careful review of all records kept by the operator.
- Personal discussions with employees.
- Personal observations on the site of the typical job operations of each employee, especially disinfectant and water quality control.
- Personal observations of the site with regard to general maintenance.
- Personal observations of how employees deal with large groups of bathers.
- Personal observations of how maintenance is carried out on the circulation, filtration, and sanitation systems.
- Personal observations of spa/hot tub structure, walkways, decks, and stairways during operation and during shutdown.

In general, health and safety problems experienced with public spas/hot tubs may be tied to facility installation and design or to operator proficiency. Installation and design problems will for the most part be discernible by observation or simple testing and can be identified and resolved by specific maintenance or structural changes. Operator proficiency, however, will continually vary depending upon the training and conscientiousness of both the operator and other employees.

Therefore, a plan of frequent (weekly) and thorough inspections by local health officials of these facilities is recommended

with careful follow-up on items found deficient in earlier inspections until a history of compliance is established. If possible, the local health authority should specify that at least one person on each shift at these facilities be trained in the operation of spa and hot tub techniques and that specific detailed recordkeeping and logs of all operational and sanitation activities be kept for review by local health authorities.

Because of the high water turnover rates, high water temperatures and water agitation, hourly testing for disinfectant residual and pH are recommended during periods of high bather load. This testing should be recorded in the logs kept by the operator. In addition, the operator should be required to keep a detailed weekly log of all reported accidents at the site.

The typical format of water tests, filter checks, and accident report forms are shown for reference (Figures 1-2). In addition, a list of emergency phone numbers and other important phone numbers applicable to public spa/hot tub operational needs is shown in Figure 3.

### 6.1 Special Situations

Occasionally situations arise with spas and hot tubs that require special attention. Some are common to all types of spas and hot tubs. Some are unique to redwood tubs, others to fiberglass units or plastered spas.

**6.1.1. Corrosion,** a frequent occurrence, is the destruction of metal by chemical or galvanic action. Plastered spas are particularly susceptible to corrosion. If left unchecked, corrosion can lead to electrical hazards, expensive replacements of heaters, pipes, and metal fittings, and early resurfacing of plaster spas. If green, brown, or cloudy water or pitting of fittings, pipes, or surface of plastered spas is detected, a corrosive condition may be present.

To minimize corrosive action:

- (a) Check that all electrical equipment is properly grounded.
- (b) Be sure two dissimilar metals are not directly connected to one another.
- (c) Make sure the operator always dilutes all chemicals, especially acids, before adding them to the spa or hot tub. These compounds should be added only in small amounts.

The Langelier Saturation Index should be considered for use in determining if the water is corrosive or scale forming (Appendix).

### 6.1.2 Scale Formation

Another special situation is scale formation, which is a result of deposits produced by crystallization and precipitation of mineral salts. Scale formation results in decreased heater efficiency and, if left unchecked, may completely plug the heater tubes. High pH values (above 7.8) and high total alkalinity (above 180 ppm) increase the rate of scaling. If the water in the spa or hot tub takes on a cloudy appearance and white chalky deposits develop, a scaling condition may be present. To minimize scale formation, ensure the chemical balance of the water (see Appendix).

### 6.1.3 Redwood Problems

Redwood is used for the construction of many hot tubs because of its high strength to weight ratio, its availability, its ease of fabrication and its natural resistance to decay. It is composed of 50% cellulose, 30% lignin and 20% natural extractives. Cellulose exists as long fibers and gives wood its strength. Lignin acts as the cementing agent for the cellulose. The extractives contain natural compounds which contribute to the resistance of decay.

Unfortunately, the extractives present in all woods are largely water soluble and will be leached from the wood by the circulating water. While the strength of the wood does not appear to be affected by leaching, the wood does become more susceptible to decay.

Wooden tubs may be coated with an approved finish to prevent this leaching and to preserve the wood's color and texture. Tub liners are also available and should be considered. Protected wood is more easily cleaned and disinfected, is less likely to harbor organisms, and is less susceptible to decay than unprotected wood.

**6.1.3.1** One of the water extractives in redwood is called tannic acid. Until the leaching process is completed, the water may take on a reddish brown color due mainly to tannic acid. If iron is also present in the water, iron tannate is formed which may color the water a blue-black color. As tubs age, leaching decreases. It may be necessary to empty the water quite frequently during the first few weeks of operation. These extractives usually are acid and may also lower the pH of the water below the recommended 7.2-7.8 levels. The tannic acid problem does not represent a hazard to bathers.

#### 6.1.3.2 Leakage

Wood shrinks when it is dry and swells when it is thoroughly soaked. Some tubs may leak when they are first filled, but as the wood swells the leaks rapidly disappear. This situation can be minimized if the operator prevents the tub from drying.

#### 6.1.3.3 Lignins

Chemical deterioration in the form of lignin removal (the cementing agent in wood) may occur when high concentrations of oxidizing agents, such as chlorine, and of alkaline chemicals, such as soda ash, are present in the water. The attack is particularly severe when the combination of excessively high chlorine residuals and high alkalinity concentrations are maintained simultaneously. The adverse effect of the wood is restricted to the surface, which becomes rough and white in color. It begins to look like white fibrous matting. Also, this condition tends to clog the filters and therefore may affect overall sanitation of the hot tub. To minimize this condition, the operator should avoid using excessive amounts of soda ash for pH adjustment and excessive amounts of chlorine compounds for shock treatment. Non-chlorine oxidizers for shock treatment of redwood hot tubs are commercially available.

#### 6.1.3.4 Fiberglass Spas

Occasionally, fiberglass spas may develop random black spotting and blistering. While the appearance of these spots may suggest an algae or fungus problem, the cause may be chemical in

nature. The discolorations usually occur at pinhole imperfections of the gelcoat. The color results from an oxidative reaction between the metal—cobalt—and chemicals in the gelcoat. This situation is not hazardous to the bather, but if left unchecked, it could result in the creation of sites for bacteria growth which cannot be cleaned out. There are commercial chemicals available to correct this condition.

## 7.0 EMERGENCY PROCEDURES

The need for emergency planning in areas of public recreation is well founded in past experience. Being prepared for problems is the best method of minimizing their consequences. Therefore, a plan for emergencies should be carefully devised and kept up to date. All employees should be trained and drilled periodically in executing the plan. A person qualified in first-aid, CPR, and advanced life saving through American National Red Cross certification should be on duty at all times during operational hours.

The emergency plan should take into consideration drownings, electrical shock, heat prostration, fractures, poisonings, cuts and burns, neck and back or spinal injuries, and exposure to chlorine gas. Each of these topics is addressed in the latest American National Red Cross handbook on first-aid, a copy of which should be on hand at the same location as the first-aid kit and emergency telephone numbers.

Each facility should have available the following first-aid supplies:

- First-Aid Kit — A standard 24-unit kit should be kept stocked and readily accessible for use.
- A stretcher and blankets.
- A standard plywood backboard or other acceptable splint made to the specifications of the American National Red Cross for back and neck injuries.

An area or room should be set aside for the emergency care of casualties.

Every facility should have posted by its phone a list of current emergency numbers such as the nearest available physician, ambulance service, hospital, rescue squad, police department and fire department.

Of course, one of the most effective ways to control emergencies is to plan for them in the original design of the facility, and wherever possible, health and safety officials should try to review and comment on the original plans and layouts before a building permit is issued.

Two types of emergencies for which evacuation procedures should be developed are:

- Major release of chlorine gas
- Power outage during nighttime operation.

### Chlorine Gas Release

Gas masks should be provided at a point accessible to the operator in the event of an emergency, generally immediately outside the chlorine room door. Front-mounted or back-mounted gas masks equipped with a chlorine-type canister may

be used with low concentrations of chlorine in the air. Self-contained breathing apparatus, with a full face piece and a cylinder of air or oxygen carried on the body, is suitable for high concentrations of chlorine and is the preferred means of protection. The apparatus should be the pressure-demand type in which the pressure inside the face piece is positive during both inhalation and exhalation. If the mask uses replaceable cartridges, specific instructions to replace the cartridge in the mask with a new one directly after every use should be posted.

In addition to the general emergency plan, a carefully devised plan specific for a chlorine gas emergency should be posted. Personnel should be drilled regularly in executing the plan.

A plan should also be devised for general evacuation of a facility. The most feasible approach is for each facility to devise an individual plan of action. This plan should be approved by local health authorities.

Disposal of chlorine can be achieved through a standby alkali absorption system. A suitable tank capable of holding the required alkaline solution should be provided. The alkali should be stored in a form so that a solution can be readily prepared

when needed. Chlorine should be passed into the solution through a connection properly submerged and weighted to hold it under the surface. The contents of a full 100-pound cylinder of chlorine can be absorbed in 300 gallons of water, or 125 pounds of caustic soda dissolved in 40 gallons of water.

#### **Power Outage**

Each facility should make provision for an emergency plan in the event of a power outage that deprives the bather of safe illumination.

Battery operated emergency lighting packs are available as standard safety items. In addition, portable lights and bullhorns should be available to personnel at all times and an evacuation plan devised. Personnel should be drilled regularly in execution of the plan.

If the power outage is temporary, no evacuation is necessary as long as emergency lighting is available. If the outage is long term, then bathers should be asked to leave the spa or hot tub and, under supervision of an employee, taken to areas where they can dress and then leave the premises.

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**Table 1**  
**Operational Parameters: Public Spas and Hot Tubs**

Listed below are guidelines for the proper treatment and maintenance of water in spas and hot tubs.

Chemical treatment alone will not produce clear and sanitary spa water. An efficient filtration system, periodic water replacement, and proper operation and maintenance by conscientious personnel also are required.

	Minimum	Ideal	Maximum	Comments		
<b>A. DISINFECTANT LEVELS</b>						
1. Free chlorine, mg/l (ppm)	2	3-5	5*	During hours of operation, test the water and record the results hourly (or use continuous reading devices), maintain this range continually, and superchlorinate (shock treat) the water at the end of the daily use period.		
2. Combined chlorine, ppm	None	None	0.2	High levels of combined chlorine result in reduced chemical efficacy. Take remedial action. See Section E-1 below.  Signs of combined chlorine: <ul style="list-style-type: none"> <li>● Sharp chlorinous odor</li> <li>● Eye irritation</li> <li>● Algae growth</li> </ul>		
3. Bromine, ppm	2	3-5	5*	During hours of operation, test the water and record the results hourly (or use continuous reading devices); maintain this range continually, and shock treat the water at the end of the daily use period.		
4. Iodine, ppm	Levels not confirmed			Note: Consult local health department officials before use.		
5. Alternative methods of disinfection, such as ozonization or ultraviolet light/hydrogen peroxide.	Levels not confirmed (follow manufacturers' recommendations)			Note: Consult local health department officials before use. Special requirements, such as free residual disinfectant or additional bacteriological testing, may be necessary.		
<b>B. CHEMICAL VALUES</b>						
1. pH	7.2	7.4-7.6	7.8	If pH is: <table border="0" style="width: 100%;"> <tr> <td style="vertical-align: top;"> <b>Too Low</b> <ul style="list-style-type: none"> <li>● Rapid dissipation of chlorine or bromine</li> <li>● Plaster and concrete etching</li> <li>● Eye discomfort</li> <li>● Corrosion of metals</li> </ul> </td> <td style="vertical-align: top;"> <b>Too High</b> <ul style="list-style-type: none"> <li>● Low chlorine efficiency</li> <li>● Scale formation</li> <li>● Cloudy water</li> <li>● Eye discomfort</li> </ul> </td> </tr> </table>	<b>Too Low</b> <ul style="list-style-type: none"> <li>● Rapid dissipation of chlorine or bromine</li> <li>● Plaster and concrete etching</li> <li>● Eye discomfort</li> <li>● Corrosion of metals</li> </ul>	<b>Too High</b> <ul style="list-style-type: none"> <li>● Low chlorine efficiency</li> <li>● Scale formation</li> <li>● Cloudy water</li> <li>● Eye discomfort</li> </ul>
<b>Too Low</b> <ul style="list-style-type: none"> <li>● Rapid dissipation of chlorine or bromine</li> <li>● Plaster and concrete etching</li> <li>● Eye discomfort</li> <li>● Corrosion of metals</li> </ul>	<b>Too High</b> <ul style="list-style-type: none"> <li>● Low chlorine efficiency</li> <li>● Scale formation</li> <li>● Cloudy water</li> <li>● Eye discomfort</li> </ul>					

\*The National Spa and Pool Institute has recommended that levels between 5 and 10 ppm be allowable to facilitate frequent shock treatments. Although health departments may consider exceptions, current data suggest that during periods of use, levels between 2 and 5 ppm free residual disinfectant are appropriate if maintained continuously in a properly operated facility.

Table 1 (Continued)

	Minimum	Ideal	Maximum	Comments
<b>B. CHEMICAL VALUES</b>				
2. Total alkalinity (buffering), ppm as CaCO <sub>3</sub>	60	80-100 For calcium hypochlorite, lithium hypochlorite, and sodium dichlor	180	If total alkalinity is: Too Low <ul style="list-style-type: none"> <li>• pH bounce</li> <li>• Corrosion tendency</li> </ul> Too High <ul style="list-style-type: none"> <li>• Cloudy water</li> <li>• Increased scaling potential</li> <li>• Tendency for pH to be too high</li> </ul>
		100-120 For sodium hypochlorite, trichlor, chlorine gas, and bromine		
3. Dissolved solids, ppm	300	—	2,000	These values are offered as guidelines only because limits have not been confirmed. Excessively high total dissolved solids (TDS) may lead to hazy water, corrosion of fixtures, etc. Consult local or State health department. High initial TDS may indicate poor water quality due to corrosive mineral salts, humus, or organic matter. Consult local water authority. Increasing TDS indicates buildup of impurities to be controlled by water replacement.
4. Hardness, ppm as CaCO <sub>3</sub>	150	200-400 to balance water	500+	Operation of spas and hot tubs at maximum hardness will depend on alkalinity (buffering) requirements of the sanitizer used. Minimum alkalinity and lower pH must be used with maximum hardness (over 500 ppm).  If hardness is: Too Low <ul style="list-style-type: none"> <li>• Plaster or concrete etching may occur.</li> <li>• Corrosion may occur.</li> </ul> Too High <ul style="list-style-type: none"> <li>• Scaling may occur.</li> <li>• Short filter runs may occur.</li> </ul>
5. Heavy metals	None	None	None	If heavy metals, such as copper, iron, or manganese, are present: <ul style="list-style-type: none"> <li>• Staining may occur.</li> <li>• Water may discolor.</li> <li>• Chlorine dissipates rapidly.</li> <li>• Filter may plug.</li> <li>• Low pH and corrosion may be indicated.</li> </ul>

Table 1 (Continued)

	Minimum	Ideal	Maximum	Comments
<b>C. BIOLOGICAL VALUES</b>				
1. Algae	None	None	None	If algae are observed: <ul style="list-style-type: none"> <li>● Shock treat the water. (Section E-1)</li> <li>● Supplement with brushing and vacuuming.</li> <li>● Maintain adequate free disinfectant residual.</li> <li>● Use approved algicide according to label directions.</li> </ul>
2. Bacteria	None	None	Refer to local code.	If bacteria count exceeds health department requirements: <ul style="list-style-type: none"> <li>● Consult the health department for required decontamination procedures.</li> <li>● Drain, clean, and disinfect the spa/hot tub, and replace the water.</li> <li>● Shock treat (E-1), and follow proper maintenance procedures.</li> <li>● Maintain proper free disinfectant residual in the spa/hot tub before reuse.</li> </ul>
<b>D. STABILIZER (If Used)</b>				
1. Cyanuric acid, ppm	10	30-50	100	If stabilizer is: <p>Too Low</p> <ul style="list-style-type: none"> <li>● Chlorine residual rapidly destroyed by sunlight</li> </ul> <p>Too High</p> <ul style="list-style-type: none"> <li>● May exceed health department regulations</li> <li>● May reduce chlorine efficacy.</li> </ul> <p>Stabilizer is not needed in indoor or brominated spas/hot tubs.</p>
<b>E. REMEDIAL PRACTICES</b>				
1. Daily shock treatment (to establish break point)	10 ppm	—	—	<ul style="list-style-type: none"> <li>● Apply at the end of daily usage period. Hold this level for 1 to 4 hours to clarify the water, remove ammonia (combined chlorine), and kill any algae present.</li> <li>● Apply when spa/hot tub is not in use and as required to maintain clear water and the required halogen residual.</li> </ul>
2. Water clarification	When needed			Treat only to maintain water clarity and supplement filtration.

**Table 1 (Continued)**

	<b>Minimum</b>	<b>Ideal</b>	<b>Maximum</b>	<b>Comments</b>
3. Water replacement	Spas/hot tubs require partial and complete water replacement periodically. Frequency recommendations are based on bather load and water quality. Water should be partially replaced as often as necessary to maintain water quality. Requirements for completely replacing the water may vary from once every 2 days - 1 month. Health departments should be consulted.			Replace water as necessary to dilute dissolved solids, to maintain water clarity, and to do necessary routine maintenance. Facility should be thoroughly cleaned and disinfected while empty. Although minimum requirements may vary, the National Swimming Pool Foundation recommends a weekly regimen.
4. Algicides	Follow manufacturers' directions.			Use U.S. Environmental Protection Agency-registered products.

**F. TEMPERATURE**

1. Temperature	--	Bather preference	104°F (40°C)	<p>If temperature is:</p> <p>Too Low</p> <ul style="list-style-type: none"> <li>● Bather discomfort</li> </ul> <p>Too High</p> <ul style="list-style-type: none"> <li>● Health hazard or bather discomfort</li> <li>● Excessive fuel requirement</li> <li>● Increased evaporation</li> <li>● Increased scaling potential</li> <li>● Increased use of halogen</li> </ul>
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**G. WATER CLARITY**

1. Water turbidity Nephelometric Turbidity Units (NTU)	0	0.5 or less	1.0	<p>If water is turbid:</p> <ul style="list-style-type: none"> <li>● Halogen level may be low.</li> <li>● Filtration system may be inoperative.</li> </ul>
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**Table 2**  
**Guidelines for Operators of Public Spas and Hot Tubs**

These guidelines are a quick, easy reference for the public spa and hot tub operator. Listed below are the most frequently needed chemical values and most obvious problems encountered when treating spa and hot tub water. Among the most important equipment the operator will need to maintain clear, sanitary spa and hot tub water are suitable test kits, automatic chemical feeding equipment, and a filtration system in proper operating condition. Section 5.4 of this publication should be consulted for additional guidelines. Safe handling and storage of chemicals is very important in operating any public spa or hot tub. Chemicals should be stored and used according to the manufacturers' directions.

	<b>Recommended Values</b>	<b>Comments</b>
<b>I. CHECK HOURLY</b>		
A. Disinfectant	2-5 ppm free residual (chlorine or bromine) (See Table 1, A)	Check chlorine value by DPD (diethyl-p-phenylenediamine) free chlorine method. Suitable test kits are available for other disinfectants. Check disinfectant hourly or continuously by automatic recording device.
B. pH	7.2-7.8	Accurate pH control is essential for proper spa/hot tub operation.
C. Temperature	104°F maximum (40° C)	Excessively high water temperature is dangerous.
<b>II. CHECK WEEKLY</b>		
A. Total alkalinity	60-180 ppm	Consult pool/spa service specialist.
B. Calcium hardness	150-500 ppm + (200-400 to balance water)	Consult pool/spa service specialist.
C. Stabilizer (cyanuric acid), if used	100 ppm maximum	Excessive chlorine requirement in outdoor pools may indicate low stabilizer value. Stabilizer is not needed or recommended for indoor spas/hot tubs.
D. Test kits	Maintain fresh reagents; clean and store vials and comparators properly.	Use only those reagents manufactured for the kit in use.
E. Water replacement needs	(See Table 1, E-3)	Inability to chemically balance water and other problems may indicate need to drain, clean, and refill. Consult health department.

**Table 2 (Continued)****III. PROBLEMS TO WATCH FOR**

<b>Symptom</b>	<b>Diagnosis/Test</b>	<b>Action/Remedy</b>
A. Odor (foul, locker-room smell)	Test free available disinfectant.	Shock treat the water following manufacturers' directions. Fresh, laundry-like smell should result. May need to drain and clean spa/hot tub and replace water.
B. Cloudiness	Check disinfectant. Check pH. Check filter and circulation system.	If low, shock treat. Adjust pH to 7.5. Backwash; if cloudiness persists, drain, clean, and refill.
C. Foaming	Check visually.	Antifoam agents may be approved. Check with manufacturer and health department.
D. Stains	Check pH. Check calcium hardness and total alkalinity.	Adjust pH to 7.5. Adjust to 200-400 and 80-100 ppm, respectively. Check with pool/spa specialist and health department.
E. Green or brown water	Test fill water for heavy metals.	Refer to Section 4.8, "Operational Parameters."
F. Mineral deposits	Check pH.	Adjust pH to 7.5. If not possible, drain and refill, and balance water chemically.

**Figure 1**  
**TYPICAL DAILY WATER QUALITY LOG**

Location: \_\_\_\_\_ Weather: \_\_\_\_\_  
 Date: \_\_\_\_\_  
 Day: \_\_\_\_\_

Time	WATER TEST			AND	FILTER CHECK		Initial
	Disinfectant Level	pH	Water Clarity		Back-wash	Temperature	
10:							
11:							
12:							
1:							
2:							
3:							
4:							
5:							
6:							
7:							
8:							
9:							
10:							
11:							
12:							

Figure 2  
TYPICAL FIRST-AID REPORT

Location \_\_\_\_\_ Date \_\_\_\_\_

Employee ( ) \_\_\_\_\_ Time \_\_\_\_\_  
Please check one a.m. p.m.

Guest ( ) \_\_\_\_\_

Victim: Name \_\_\_\_\_ Age \_\_\_\_\_

Address \_\_\_\_\_

City \_\_\_\_\_ State \_\_\_\_\_ Zip \_\_\_\_\_

Phone \_\_\_\_\_

What Happened – Victim Statement:

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

As the victim of this accident, I hereby certify that the above statement is true to the best of my knowledge.

Signature of Victim: \_\_\_\_\_

Location of Accident: \_\_\_\_\_

\_\_\_\_\_

Witness: Name \_\_\_\_\_

Address \_\_\_\_\_

City \_\_\_\_\_ State \_\_\_\_\_ Zip \_\_\_\_\_

Phone \_\_\_\_\_

Statement of Witness:

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

Describe Injury: \_\_\_\_\_

\_\_\_\_\_



**EMERGENCY PHONE NUMBERS**

Location \_\_\_\_\_

POLICE \_\_\_\_\_ SHERIFF \_\_\_\_\_

HWY PATROL \_\_\_\_\_ AMBULANCE \_\_\_\_\_

FIRE DEPT \_\_\_\_\_ HOSPITAL \_\_\_\_\_

**OTHER IMPORTANT PHONE NUMBERS**

**PLUMBER:**

Company \_\_\_\_\_ Phone \_\_\_\_\_

Person \_\_\_\_\_ Home Phone \_\_\_\_\_

Other Emp \_\_\_\_\_ Home Phone \_\_\_\_\_

**GENERAL CONTRACTOR:**

Company \_\_\_\_\_ Phone \_\_\_\_\_

Person \_\_\_\_\_ Home Phone \_\_\_\_\_

Other Emp \_\_\_\_\_ Home Phone \_\_\_\_\_

**ELECTRICIAN:**

Company \_\_\_\_\_ Phone \_\_\_\_\_

Person \_\_\_\_\_ Home Phone \_\_\_\_\_

Other Emp \_\_\_\_\_ Home Phone \_\_\_\_\_

**SWIMMING POOL SUPPLY:**

Company \_\_\_\_\_ Phone \_\_\_\_\_

Person \_\_\_\_\_ Home Phone \_\_\_\_\_

Other Emp \_\_\_\_\_ Home Phone \_\_\_\_\_

**VENDING MACHINE COMPANY:**

Company \_\_\_\_\_ Phone \_\_\_\_\_

Person \_\_\_\_\_ Home Phone \_\_\_\_\_

Other Emp \_\_\_\_\_ Home Phone \_\_\_\_\_

## GLOSSARY

**Air Induction System** — A system whereby air is induced into ducting built into or affixed on a spa floor, bench or other location. The Air Induction System is activated by a separate Air Power Unit.

**Alkalinity** — The amount of bicarbonate, carbonate, or hydroxide compound present in water solution.

**Antivortex Drain** — A drain with a raised cover designed to prevent the vacuuming effect on a body which may come in contact with the drain.

**Backwash** — The process of thoroughly cleansing the filter media and/or elements by reverse flow.

**Backwash Cycle** — The time required to thoroughly backwash the filter media and/or elements and the contents of the filter vessel.

**Backwash Rate** — The rate of application of water through a filter during the cleaning cycle. It is normally expressed in U.S. gallons per minute per square foot of effective filter area.

**Band** — See Hoop.

**Breakpoint Chlorination** — When chlorine is added to water containing ammonia it reacts with the ammonia to form chloramines. If more chlorine is added to the water, the total residual chlorine continues to rise until the concentration reaches a point that forces the reaction with ammonia to go rapidly to completion. Compounds of nitrogen and chlorine are released from the water, and the apparent residual chlorine decreases. The point at which the residual suddenly drops is called the breakpoint. When enough chlorine is added to pass the breakpoint, all combined chlorine compounds disappear, eye irritation potential and “chlorine odors” disappear, and the chlorine that remains in the water is all in the free state. The breakpoint occurs at different concentrations in different waters. Superchlorination usually results in exceeding the breakpoint.

**Deck, Above-Ground** — Any structure that is on top of or adjacent to the outer edges of the spa/hot tub/pool that can support person(s) in a sitting or upright position.

**Decks** — Those areas surrounding a spa or hot tub which are specifically constructed or installed for use by bathers.

**Effective Filter Area** —

**Permanent Media Type:** The effective filter area is the cross section area of the filter surface that is perpendicular to the flow direction.

**Cartridge Filter:** The total effective filter area is that cartridge area which is exposed to the direct flow of water. This excludes cartridge ends, seals, supports and other areas where flow is impaired.

**Face Piping** — The piping, with all valves and fittings, which is used to connect the filter system together as a unit.

**Factor of Safety** — The ultimate load divided by the safe load or the ultimate strength divided by the allowable stress.

**Filter** — A device that separates solid particles from water by recirculating it through a porous substance (a filter media or element).

**Permanent Media Filter:** A filter that utilizes a media that can be regenerated and will not have to be replaced.

**Diatomaceous Earth Filter:** A filter that utilizes a thin layer of filter aid as its filter media. The aid must be replaced periodically.

**Cartridge Filter:** A filter that utilizes a porous cartridge as its filter media.

**Filter Agitation** — The mechanical or manual movement to dislodge the filter aid and dirt from the filter element.

**Filter Cycle** — The operating time between cleaning and/or backwash cycles.

**Filter Element** — A device within a filter tank designed to entrap solids and conduct water to a manifold collection header, pipe or similar conduit. Filter elements usually consist of a septum and septum support.

**Permanent Filter Media:** A finely graded material (such as sand, anthracite, etc.) which removes filterable particles from the water.

**Filter Aid:** A type of finely divided medium used to coat a septum type filter; usually diatomaceous earth, processed perlite or similar material.

**Filtration Flow** — The rate of flow, in volume per time (GPM, GPH), through the filter system installed per manufacturer’s instructions with new clean media.

**Filtration Rate** — The rate of filtration of water through a filter during the filter cycle expressed in U.S. gallons per minute per square foot of effective filter area.

**Head** — A basic measurement of pressure or resistance in a hydraulic system which is equivalent to the height of the column of water which would cause the same resistance. The *total head* is the sum of all the resistance in an operating system (energy per unit weight of flowing fluid).

**Hoop** — A circumferential constraint that prohibits the reaction to the pressure tending to separate the staves in a hot tub.

**Hot Tub** — A hydrotherapy spa constructed of wood with sides and bottoms formed separately; and the whole shaped to join together by pressure from the surrounding hoops, bands or rods; as distinct from spa units formed of plastic, concrete, metal, and other materials.

**Hydrojets** — A fitting which blends air and water creating a high velocity, turbulent stream of air enriched water.

**Hydrotherapy Spa** — A unit designed for recreational and therapeutic use which is not drained, cleaned or refilled for each user. It may include, but not be limited to hydrojet circulation, hot water, cold water mineral baths, air induction bubbles, or some combination thereof. Industry terminology for a spa includes, but is not limited to, “therapeutic pool,” “hydrotherapy pool,” “whirlpool,” “hot spa,” “hot tubs,” etc.

**Liner** — That membrane that acts as a container for the water.

**Expandable Liner:** A liner that is constructed of a material that has the capability of stretching into a depth or shape other than the original construction dimensions.

**Hopper Liner:** The liner that is used to obtain greater depth by geometrical pattern construction of the liner bottom to fit a predetermined size or shape.

**Loads** — The weights of materials used in building construction are tabulated and classified as dead loads. Live loads are generally considered to be uniformly distributed and are classified according to occupancy.

**Multiport Valve** — A separate switching valve with a separate position for each of the various filter operations. This valve combines in one unit the functions of several direct-flow valves.

**Nephelometric Turbidity Units (NTU's)** — A measure of water clarity.

**Overflow System** — The term encompasses perimeter type overflows, surface skimmers and surface water collection systems of various design.

**Pinching Hazard** — Any configuration of components that would pinch or entrap the fingers or toes of a child or adult.

**Pools** —

**Above-Ground Spa/Hot Tub:** A pool of any shape that is deeper than 24" (61 cm) or holds more than 2,500 gallons of water or has a water surface area in excess of 150 square feet. The above-ground pool is located entirely above-ground (i.e., with no excavated portions) and has a constant depth.

**In-Ground Spa/Hot Tub:** Any spa/hot tub/pool whose sides reside partially or fully below the natural ground level.

**Non-Permanently Installed Spa/Hot Tub:** Any pool that is so constructed that it may be readily disassembled for storage and reassembled to its original integrity.

**On-Ground Spa/Hot Tub:** Any pool whose sides rest fully above the surrounding earth and which has a deep area below ground level.

**Permanently Installed Spa/Hot Tub:** One that is constructed in the ground, or in a building, in such manner that the pool cannot be readily disassembled for storage.

**Public Spa and Hot Tubs** — Any spa and/or hot tub, other than a residential spa or hot tub which is intended solely for bathing and is operated by an owner, lessee, operator, licensee, or concessionaire, regardless of whether a fee is charged for use. Public spas and hot tubs may be individual units or may be integrated into a larger swimming pool or bathing pool.

**Recessed Steps** — A riser/tread or series of risers/treads extending down from the deck with the bottom riser/tread terminating at the spa/hot tub/pool wall, thus creating a “stairwell.”

**Recessed Treads** — A series of vertically spaced cavities in the spa/hot tub/pool wall creating tread areas for stepholes.

**Removable** — Capable of being taken away from the main unit with the use of only simple tools, such as a screwdriver, pliers or wrench.

**Rod** — See Hoop.

**Septum** — That part of the filter element consisting of cloth, wire screen or other porous material on which the filter medium or aid is deposited.

**Spa** — A hydrotherapy unit (see Hydrotherapy Spa) of irregular or geometric shell design.

**Spray Rinse, Mechanical** — A fixed or mechanically movable spray system which directs a stream of water against the filter surface, causing the filter aid and accumulated dirt to dislodge into the empty tank.

**Superchlorination (Shock Treatment)** — This refers to raising the residual chlorine level to 10 ppm for several hours to clarify the water, remove ammonia (combined chlorine) and to kill any algae present. This procedure is necessary on a routine basis as required (daily/weekly) to maintain acceptable water conditions.

**Tamperproof** — Tools are required to alter or remove portions of the equipment.

**Tread Contact Surface** — Foot contact surfaces of ladder, step, stair or ramp.

**Turnover** — The period of time (usually in hours) required to circulate a volume of water equal to the pool capacity. The *turn-over rate* is the number of times a quantity of water equal to the

pool capacity passes through the filters in a stated time (usually in turnovers per day).

**Water Line** — The water line shall be defined in one of the following ways:

- a. **Skimmer System** — The water line shall fall in the mid-point of the operating range of the skimmers.
- b. **Overflow Systems** — The water line shall be established by the height of the overflow rim.

## ADDITIONAL TECHNICAL TERMS\*

**Air Pump Assist Backwash** — The compressing of a volume of air in the filter effluent chamber (by means of an air compressor or by the water pressure from the recirculating pump) which, when released, rapidly decompresses and forces water in the filter chamber through the elements in reverse, dislodging the filter aid and accumulated dirt, carrying it away as waste.

**Cartridge** — A replaceable porous element.

**Depth Type Cartridge:** A filter cartridge with media not less than 3/4" (.18 cm) thick which removes particulates as they penetrate into the media.

**Surface Type Cartridge:** A filter cartridge with media less than 3/4" (.18 cm) thick which relies on retention of particulates on the surface of the cartridge to achieve their removal.

**Chine** — That portion of the stave of a hot tub below the bottom of the croze.

**Chine Joist** — A brace that provides supports to the floor of a hot tub.

**Cold Crack** — The temperature at which the liner material will physically crack when folded 180 degrees on itself. See ASTM Specification D. 1790, "Brittleness, Temperature of Plastic Film By Impact," revised 1970.

**Croze** — The milled groove in the stave of a wooden hot tub that accommodates the floor boards.

**Edge Guards** — Shields designed to cover sharp edges in above-ground spas or hot tubs.

**Filter Vacuum (or Suction)** — A filter which operates under a vacuum from the suction of a pump.

**Floor** — Shall refer to the interior bottom spa/hot tub/pool surface and consists of that surface from a horizontal plane up to a maximum of a 45° slope.

**Freeboard** — The clear vertical distance between the top of the filter media and the lowest outlet of the upper distribution system in a permanent media filter.

**Lower Distribution System (Underdrain)** — Those devices used in the bottom of a permanent media filter to collect the water uniformly during the filtering and to distribute the backwash uniformly during the backwashing.

**Precoat** — The coating of filter aid on the septum of a diatomite type filter at the beginning of each filter cycle.

**Primary Structural Members** — Any part of the structure that carries or retains for reasonable foreseeable use any static or dynamic load or stress caused by water pressure, surcharge and/or natural forces.

**Secondary Structural Members** — Any part of the above-ground structure that is not subject to load caused by water pressure.

**Upper Distribution System** — Those devices designed to distribute the water entering a permanent media filter in a manner such as to prevent movement or migration of the filter media. This system shall also properly collect water during filter backwashing unless other means are provided.

**Upright Supports** — That portion of the frame which is adjacent to the above-ground wall in a vertical position which supports the top rail and braces the wall.

\*Many of the terms included in this list do not appear in the text. However, since they are relevant to this particular industry, their inclusion in these guidelines was felt to be beneficial.

**APPENDIX**  
**LANGELIER SATURATION INDEX**

The Saturation Index (S.I.), determined by the following formula, is useful in determining if water is corrosive (undersaturated) or scale forming (oversaturated).

$$\text{S.I.} = \text{pH} + \text{TF} + \text{CF} + \text{AF} - 12.1$$

pH, actual reading

12.1, constant

TF, temperature factor (table)

CF, calcium hardness factor (table)

AF, total alkalinity factor (table)

**Numerical Values for S.I. Formula**

Temp. F (C)	TF	Calcium Hardness	CF	Total Alkalinity	AF
32 (0)	0.0	5	0.3	5	0.7
37 (3)	0.1	25	1.0	25	1.4
46 (8)	0.2	50	1.3	50	1.7
53 (12)	0.3	75	1.5	75	1.9
60 (16)	0.4	100	1.6	100	2.0
66 (19)	0.5	150	1.8	150	2.2
76 (24)	0.6	200	1.9	200	2.3
84 (29)	0.7	300	2.1	300	2.5
94 (34)	0.8	400	2.2	400	2.6
105 (40)	0.9	800	2.5	800	2.9
128 (53)	1.0	1,000	2.6	1,000	3.0

Balanced water = S.I. between -0.5 and +0.5

Corrosive water = S.I. below -0.5

Scale forming = S.I. above +0.5

Example: Given temperature 102°, total hardness 200 ppm, total alkalinity 100 ppm, CaCO<sub>3</sub> and pH = 7.6

$$\text{S.I.} = \text{pH} + \text{TF} + \text{CF} + \text{AF} - 12.1$$

$$\text{S.I.} = 7.6 + 0.9 + 1.9 + 2.0 - 12.1 = (+) 0.3$$

Therefore, the saturation index is close to 0, and the water is considered chemically balanced.

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