and disinfected regularly. If water becomes cloudy or smelly (indicative of extensive microbial contamination), drain the feature completely, followed by thorough cleaning and disinfection. This is particularly important in dusty areas.

- Avoid locating decorative fountains in high-risk areas including hospitals
- Ensure routine maintenance of decorative fountains and disinfection in accordance with the manufacturer’s instructions. Automatic control and feed of biocide is preferable. Maintain at least 0.5 ppm free chlorine or equivalent continuously.
- When water treatment is inactive for three or more days (less in high temperatures or dirty conditions), features should be drained completely, cleaned and disinfected.
- A maintenance log should be maintained for all ornamental water features i.e. free chlorine levels, water temperature, visual inspection for cloudy water and areas of slime, filter inspections, filter cleaning, filter changes, pump cleaning (every 3 months), water changes and routine cleaning.
- Cleaning and maintenance of ornamental water features should form part of the overall risk management strategy for the premises concerned. A competent person(s) should be responsible for maintaining the feature. It should form part of the normal infection control environmental sampling programme.

8.5 Spa pools

8.5.1 Definition

This section on spa pools is based on and should be read with particular reference to the following document: Management of spa pools: controlling the risk of infection, published by the UK Health and Safety Executive and HPA, 2006. Available at http://www.hpa.org.uk/publications/2006/spa_pools/spa_pools.pdf.

A spa pool is a self-contained body of warm, agitated water designed for sitting or lying in up to the neck and not for swimming. It is not drained, cleaned or refilled after each user but after a number of users or a maximum period of time. It is filtered and chemically disinfected.

Spa pools contain water heated to 30°C - 40°C and have hydrotherapy jet circulation with or without air induction bubbles. They can be sited indoors or outdoors. Common terms for spa pools include hot spa, hot tub, whirlpool spa and portable spa. Jacuzzi is the registered trade name of a specific manufacturer and should not be mistaken for a generic name for spa pools.

Commercial spa pools

A commercial spa pool is an overflow/level deck spa pool installed in a commercial establishment or public building and generally used by people visiting the premises. Typical sites for commercial spa pools include hotels, health clubs, beauty salons, gymnasia, sports centres and clubs, swimming pool complexes and holiday camps. A spa pool in such a location is considered commercial even if payment for use is not required.

Thalassotherapy pools use seawater or sea products e.g. seaweed, for health or beauty benefits. Many of the principles that apply to spa pools also apply to these.

A domestic spa pool installed in a hotel bedroom or holiday home should also be managed as a commercial spa pool. Similarly spa pools rented out to domestic dwellings for parties, etc. must also be considered commercial.

Domestic spa pool

A domestic spa pool or hot tub is a freeboard or overflow/level deck spa pool installed at a private residence for the use of the owner, family, and occasional invited guests.

Whirlpool baths

These are typically used in beauty parlours, health suites, hotels and dwellings. They are also being used in healthcare premises. Water within the bath is untreated and the bath is drained following each use. Whirlpool baths experience similar problems to spa pools with the formation of biofilm within the pipework system associated with the air and water booster jets, so regular disinfection is recommended. They are unsuitable for use in healthcare facilities as the risks outweigh the benefits.
Natural spas

The hazards associated with the use of natural spas are essentially the same as with artificial spa pools.148

8.5.2 Infection risk

Spa pools are potentially a high-risk source of pathogenic microorganisms, including *Legionella*. They should be designed, installed, managed and maintained with control of microbial growth in mind.2 Spa pools are much smaller than swimming pools and have a higher ratio of bathers to water volume so the amount of organic material in spa pool water is far higher than in swimming pool water. They also have an extensive surface area within the pipes used to provide both the air and water-driven turbulence.148 The pipes and balance tank are often inaccessible and difficult to clean and drain and may have areas of stagnation which allows biofilm to grow. The pipes above the waterline often do not receive disinfection from the pool water which also predisposes them to biofilm formation.3

Infectious agents can easily be introduced to a spa pool via bathers, from dirt entering the pool or from the water source itself. Once in the spa pool, conditions often exist which promote the growth and proliferation of these agents.148 *Legionella* bacteria frequently grow in poorly designed and poorly managed spa pools. The water is vigorously agitated and this leads to the formation of aerosols that can be inhaled. This means even people not in the immediate vicinity of the spa pool can breathe in the aerosol.3 There have been a number of outbreaks of legionnaires’ disease associated with spa pools in recent years.10;149 Spa pools are the commonest source of legionnaires’ disease outbreaks on cruise ships (see Section 8.6). Water disinfection is therefore a key control measure in spa pools although the raised temperature and high organic content can make it difficult to maintain effective disinfection.148

8.5.3 Duties of designers, manufacturers, importers and suppliers

Under section 16 of the Safety, Health and Welfare at Work Act 2005,150 a person who designs, manufactures, imports or supplies a spa pool, must ensure, as far as is reasonably practicable, that the pool is designed and constructed so as to be safe and without risk to health when properly used by a person at work. They must ensure that adequate information is provided to ensure its safe use including information on its safe installation, maintenance, cleaning, dismantling or disposal. Any revisions of the information must also be provided if a serious risk to health or safety becomes known.

Consideration should be given to the materials used during design and installation, avoiding materials that support microbial growth. All parts of the system should be accessible to facilitate easy cleaning, disinfection and maintenance. Spa pools should not be located too near swimming pools.

8.5.4 Identification and assessment of the risk associated with spa pools

It is the responsibility of the person operating a spa pool (duty holder) to ensure that persons in or around the spa pool are not exposed to infectious agents including *Legionella* (not applicable to spa pools used for domestic purposes). In order to do this a written risk assessment must be undertaken. When conducting a risk assessment of a spa pool, the individual nature of the premises and spa pool should be considered. In this regard, it is important to have an up-to-date schematic diagram of the spa pool and associated plant. This can be used to decide which parts of the spa pool pose a risk to workers and users.148

The person conducting the risk assessment should have adequate knowledge, training and expertise to understand and control the risk associated with *Legionella* in spa pools. They should also have the authority to collect all the information needed to do the assessment and to make the right decisions about the risk and precautions or control measures needed.

8.5.5 General factors to be considered in the risk assessment

General factors to be considered in the risk assessment include:148

- The source of the water supply e.g. from the mains supply or an alternative
- Possible sources of contamination of the supply water e.g. biofilms within the pipework, bathers, soil, grass, and leaves (for outdoor spa pools)
- The normal operating features of the spa pool
- The people who will be working on or in the vicinity of the spa pool or using it
- The measures taken to adequately control exposure, including the use of PPE if necessary
- Breakdowns, etc.
8.5.6 Specific factors to consider

Specific factors to consider include:

- The type, design, size, approximate water capacity and designed bather load of the spa pool
- The type of dosing equipment including the use of automatic controls, pump arrangements, balance tanks and air blowers
- The piping arrangements and construction materials
- The type of filtration system
- The heat source and design temperature
- The chemical dosing equipment including chemical separation, PPE, and chemical storage arrangements
- The type of treatment to control microbiological activity e.g. chlorine or bromine. Bromine treated pools are more likely to have poor results than chlorine treated pools
- The method used to control pH, e.g. sodium bisulphate
- The cleaning regime – ease of cleaning, what is cleaned, how and when
- The testing regime including microbiological tests, the frequency of tests, operating parameters, action required when results are outside the parameters.

The significant findings of the risk assessment should be recorded. The written risk assessment should be linked to other health and safety records e.g.

- An up-to-date plan of the spa pool and plant
- The description of the correct and safe operation of the spa pool
- The precautions to take when running and using the spa pool
- The checks required to ensure the spa pool is working safely and
- Remedial action required in the event that the spa pool is not running safely.

The risk assessment should be reviewed at least annually and whenever there is a reason to suspect that it is no longer valid e.g.

- There are changes to the spa pool or the way it is used
- There are changes to the premises in which the spa pool is installed
- If changes are made to the disinfection procedures
- New information is available about the risks or control measures
- The results of tests indicate control measures are not effective
- An outbreak of disease e.g. legionnaires’ disease is associated with the spa pool.

8.5.7 Managing the risk

Everyone involved in the risk assessment and management of spa pools should be competent, trained and aware of their responsibilities. The control measures and their implementation should be regularly monitored. Staff responsibilities and lines of communication need to be clearly defined and documented.

8.5.8 Records

The following records should be kept:

- The names of the people responsible for conducting the risk assessment, managing and implementing control measures
- The significant findings of the risk assessment
- The scheme for controlling the microbiological hazard and details of its implementation
- The results of any monitoring, inspection, test or check carried out on the spa pool, along with dates.

The records must be available for inspection by the HSA and should be available for inspection by environmental health officers. The results of monitoring, inspections, testing or checks should be kept for at least five years.
8.5.9 Monitoring
It is the responsibility of the owner to arrange routine microbiological or chemical testing. Poolside testing and recording of residual disinfectant and pH levels should be undertaken before the spa pool is used each day and thereafter at least every two hours in commercial spa pools. The following on-site indicators should be monitored:

- Colour of the water
- Clarity
- Temperature
- Chlorine (free, total and combined) or bromine levels in pool
- pH
- Number of bathers.

The residual disinfectant and pH levels that should be maintained are set out in Table 14 below:

<table>
<thead>
<tr>
<th>Disinfectant used</th>
<th>Desired level</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chlorine</td>
<td>Free chlorine residual of 3-5mg/l</td>
</tr>
<tr>
<td>Bromine</td>
<td>Total active bromine of 4-6mg/l</td>
</tr>
<tr>
<td>pH</td>
<td>7.0-7.6</td>
</tr>
</tbody>
</table>

Information obtained from regular monitoring can indicate:

- Whether or not water replacement and backwashing are being undertaken at sufficient frequency
- Disinfectant levels are adequate
- Show whether or not the operation of the water treatment plant is coping effectively with the bather load
- Highlight any unnecessary hand dosing of water treatment chemicals
- Provide information on the condition of the filter bed
- Provide advanced warning of failure of filter, pumps, valves, etc.

Laboratory analysis is not part of the daily regimen but frequency should be indicated by the risk assessment. The total dissolved solids (TDS) should be monitored daily, and the water balance weekly if required.

Routine microbiological analysis should also be undertaken to ensure that optimum water treatment conditions are being maintained. While chemical analysis is of benefit to monitor the efficiency of the water treatment system in dealing with the pollution loading, it is important that it is carried out together with microbiological analysis to enable a complete assessment of the water treatment operation and management.

Microbiological samples for indicator organisms should be taken at least once a month as a routine and quarterly for *Legionella*. More frequent sampling may be required depending on the risk assessment, e.g. if the spa pool is being intensively used or if there are any adverse health effects reported by the bathers. Spa pools that are situated outdoors have additional demands placed on the disinfection and filtration systems from environmental contamination by dust, debris, etc. Microbiological sampling should also be done when a spa pool is first used or recommissioned, or there are alterations in the treatment/maintenance regimes.

Routine sampling should be done when the spa pool is in use, preferably when heavily loaded or immediately thereafter. Table 15 shows the guidelines for interpretation of the *Legionella* sampling results.
<table>
<thead>
<tr>
<th>No. of Legionella bacteria (cfu/litre)</th>
<th>Interpretation</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;100</td>
<td>Under control</td>
</tr>
<tr>
<td>≥ 100 to ≤ 1,000</td>
<td>Resample and keep under review&lt;br&gt;Advising to drain, clean and disinfect&lt;br&gt;Review control and risk assessment; carry out remedial actions identified&lt;br&gt;Refill and retest next day and 2-4 weeks later</td>
</tr>
<tr>
<td>&gt;1,000</td>
<td>Immediate closure. Exclude public from pool area&lt;br&gt;Shut down spa pool&lt;br&gt;Shock the spa pool with 50mg/l free chlorine circulating for one hour or equivalent&lt;br&gt;Drain, clean and disinfect&lt;br&gt;Review control and risk assessment; carry out remedial actions identified&lt;br&gt;Refill and retest next day and 2-4 weeks later&lt;br&gt;Alert the local departments of public health and environmental health&lt;br&gt;Keep closed until legionellae are not detected and the risk assessment is satisfactory</td>
</tr>
</tbody>
</table>

Source: Adapted from the UK Health and Safety Executive/Health Protection Agency Management of Spa Pools

Well-operated spa pools should not normally contain *Legionella* species. The microbiological results should not be considered in isolation but in the context of the management records for the spa pool.

### 8.5.10 Summary of spa pool checks (excluding domestic pools)

#### Daily

*Before opening the spa pool*

- Check the log from the day before
- Check water clarity before first use
- Check automatic dosing systems are operating (including ozone or ultraviolet (UV) lamp if fitted)
- Check that the amounts of dosing chemicals in the reservoirs are adequate
- Determine pH value and residual disinfectant concentration.

*Throughout the day*

- Continue to check automatic dosing systems are operating (including ozone or UV lamp if fitted)
- Determine pH value and residual disinfectant concentration every two hours
- Determine the TDS, where appropriate.

*At the end of the day after closing the spa pool*

- Clean water-line, overflow channels and grills
- Clean spa pool surround
- Backwash sand filter (ensure water is completely changed at least every two days) - for diatomaceous earth filters comply with the manufacturer’s instructions. Backwashing should be carried out last thing at night when there are no users in the pool. There is effectively no disinfectant in the water when backwashing is being carried out and leaving overnight allows the sand to settle again
- Inspect strainers, clean and remove all debris if needed
- Record the throughput of bathers, unless water is being changed continuously
- Record any untoward incidents.
To be done at every drain and refill

- Drain and clean the whole system including balance tank at least once weekly
- Clean strainers
- Check water balance after the refill, if necessary.

Monthly

- Microbiological tests for indicator organisms
- Full chemical test (optional)
- Clean input air filter when fitted
- Inspect accessible pipework and jets for presence of biofilm; clean as necessary
- Check all automatic systems are operating correctly e.g. safety cut-outs, automatic timers, etc.
- Disinfectant/pH controller - clean electrode and check calibration (see manufacturer’s instructions).

Quarterly

- Thoroughly check sand filter or diatomaceous earth filter membranes
- Where possible clean and disinfect airlines
- Legionella tested by laboratory.

Annually

- Check all written procedures are correct
- Check sand filter efficiency.

Source: HSE and HPA Management of spa pools: controlling the risks of infection (summary of checks, Section 2.3.8)\(^{148}\)

8.5.11 Hydrotherapy pools

The terms hydrotherapy spas or hydrotherapy pools refer to heated water pools (typically 36°C -37°C) used for special medical or medicinal purposes. Hydrotherapy pools are usually located within healthcare facilities, in which healthcare staff such as physiotherapists, perform treatments on patients for a range of physical symptoms. Hydrotherapy pools are not drained, cleaned or refilled after each use but following a number of uses or a maximum time period. Many of the principles that apply to the control of Legionella and other potentially infectious microorganisms in swimming pools and spa pools also apply to hydrotherapy pools.\(^{148;151;152}\) In general, much of the guidance provided in this document relating to spa pools can be directly applied to hydrotherapy pools. Some additional guidelines regarding management of hydrotherapy pools to reduce infection risks, including Legionella, are provided below.

Appropriate management of hydrotherapy pools is necessary to maintain the proper balance of water conditioning (i.e. alkalinity, hardness, and temperature) and disinfection. The most widely used chemicals for disinfection of hydrotherapy pools are chlorine and chlorine compounds. Water supply pipes, pumps and filters have to be well maintained to minimise the potential of this equipment acting as a reservoir for waterborne microorganisms. Patients who suffer with faecal incontinence or who have open infected wounds should refrain from using hydrotherapy pools until their condition resolves.

Maintenance of hydrotherapy poolside

- The poolside area should be cleaned daily with pool water
- The poolside area should be cleaned weekly using a solution containing 200 ppm of free chlorine
- In the event of soiling, the soiled area should be cleaned immediately
- The pool chamber should be subject to regular maintenance.

Maintenance of hydrotherapy pool water

- There should be regular monitoring and record keeping
- The pool water turnover time should not exceed 60 minutes
- The appearance of the water at the beginning of each day should be noted with respect to colour and turbidity
- The pool water should appear clear before a patient enters. Turbidity, cloudiness or the presence
of visible particulate matter indicates poor water quality

- The number of patients treated in the pool at each session should be recorded (each hour of use should be divided into three 15-minute treatment sessions with a 5-minute break)
- Patients should not stay in the pool for more than one session
- Back flushing of water filters should occur at a frequency to maintain water quality
- The pool water volume should be maintained with water directly from a mains water supply
- Equipment used for measuring pH, chlorine levels, etc. should be well maintained and subject to periodic maintenance and calibration.

**Testing of hydrotherapy pool water**

- The pH of water should be measured at the beginning of the day, then every two hours and at the end of each day. It should be within the range 7.2 - 7.8
- The temperature of the water should be recorded twice daily and should be kept between 35.5°C and 36°C
- The free chlorine should be measured three times a day and should fall between 1.5 and 5.0 mg/l. The total chlorine should be measured once with the free chlorine to give the combined chlorine (total chlorine-free chlorine). Free chlorine should not exceed one-third of the total chlorine
- TDS should be measured daily and should not exceed 1,500 mg/l respectively.

**Testing the microbiological quality of hydrotherapy pool water**

- Total bacterial counts should be measured weekly and should ideally be below 10 cfu/ml and remedial action should be taken if the counts exceed 100 cfu/ml. Coliforms, *Escherichia coli* and *P. aeruginosa* should be less than 1 cfu/100 ml.

### 8.6 Legionellosis aboard ships

Travelling aboard ship or being aboard ship is an established risk factor for legionellosis. There have been numerous cases of legionellosis acquired on ships and thus appropriate management of wet environments on ships is vital to prevent such outbreaks. Essential control measures, such as proper disinfection, filtration and storage of source water, avoidance of dead legs and regular cleaning and disinfection of spa pools are required to minimise the risk of legionellosis on ships. The World Health Organization (WHO) currently provides comprehensive guidance on *Legionella* risk assessment and control measures in relation to ships in its document *Guide to Ship Sanitation*. This document should be consulted for detailed guidance relating to the management of *Legionella* risks aboard ships.

#### 8.6.1 Risk factors associated with ships

Ships are considered to be high-risk environments for the proliferation of *Legionella* bacteria for a variety of reasons:

- Source water quality could be of potential health concern if it is untreated or if only treated with a residual disinfectant prior to or upon uploading onto ships
- Water storage and distribution networks on ships are complex and could provide greater opportunities for bacterial contamination as ship movement increases the risk of surge and back-siphonage
- Bacterial proliferation is encouraged due to long-term storage and stagnation in tanks or within the water distribution pipework
- Loaded water may vary in temperature and under certain climatic conditions the risk of bacterial growth is increased because of higher water temperatures.

#### 8.6.2 Controlling the risks

Ships should be supplied with potable water. However, even if there are low numbers of *Legionella* bacteria in the water taken aboard ship, *Legionella* bacteria can still proliferate due to factors within the ship environment, including periods of water stagnation and elevated water temperatures. The occurrence of high densities of *Legionella* bacteria in drinking water aboard ship is avoidable through the implementation of basic water quality management procedures:

- Only potable water should be supplied to ships. Water should be treated appropriately if it is