Scottish Health Technical Memorandum 2040

(Part 3 of 6)

Operational management

The control of legionellae in healthcare premises - a code of practice

IMPORTANT NOTE
LEGIONELLA
SHTM 2040 and the HSC Approved Code of Practice and Guidance (L8) 2000

HSC's Approved Code of Practice came into effect on 8 January 2001. At this time i.e. December 2001 the UK Health Department's Guidance HTM 2040 (SHTM 2040 in Scotland) has not been aligned with the ACOP. Work is ongoing but it is unlikely that HTM 2040 and SHTM 2040 will be updated until late 2002 and launched on a UK basis.

L8 takes cognisance of 'hospitals' but requires considerable interpretation for practical application. The revised UK Health Department Guidance will undertake to address this issue.

In the meantime this version of SHTM 2040 must be read as subordinate to the new ACOP.

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NHSScotland, P&EFEx, December 1999

Contents

1. Scope

General

1.1 The guidance contained in this volume is applicable to new and existing sites, and is for use at various stages during the inception, design, upgrading, refurbishment, extension and maintenance of a building.

1.2 The approach should be to remove all potential sources of seeding, growth and spread of legionellae. Where this ideal cannot be achieved in existing situations, steps should be taken to control and prevent legionellae by sound operational management.

1.3 The control of legionellae is a continuing responsibility. The effectiveness of precautionary measures should be continually monitored, and a continuing programme to ensure awareness should be devised. Although knowledge of legionellosis has improved markedly in recent years, there is a continuing misunderstanding about the method of dissemination. Many people are under the impression that cooling towers are the only source of legionellae in building service systems. All water systems are capable of colonisation by legionellae, and taps are just as capable of generating an aerosol as showers or, indeed, cooling towers.

1.4 The biggest risk is complacency, leading to the deterioration of water hygiene to such an extent that an outbreak of the disease occurs.

1.5 This SHTM does not include advice on water supplies for clinical equipment such as dialysers, nebulisers and respiratory humidifiers, or for water services for pharmacy and dental departments. Users of clinical humidifiers and nebulisers are reminded that sterile water, not tap water, should be used, and the equipment should be emptied and cleaned thoroughly following each period of use. All equipment with water reservoirs should be stored dry. Water for any other purpose should meet any identifiable local requirements, but users must recognise that any water system may provide a suitable environment for legionellae and other water-borne organisms.

1.6 SHTM 2027; *Hot and cold water supply, storage and mains services* should be consulted for guidance on the general design and operation of water systems in healthcare premises.

Application to premises

1.7 Precautions to prevent outbreaks of legionnaires' disease are required even in those premises which to date have not been infected. The guidance

should be used for all sites where there is in-patient or out-patient accommodation, for example hospitals, clinics, health centres and Blood Transfusion Service premises.

Priorities

1.8 Premises designed since 1988 should be in compliance with 'The Control of Legionellae in Health Care Premises – A Code of Practice', HMSO (1988).

1.9 All existing premises should be regularly reviewed to identify where they do not meet the advice in this SHTM. A realistic programme should be prepared to eradicate any shortfall. Priority should be given to patient areas, although the exact priority will depend on local circumstances.

NOTE: Reference must be made to Health and Safety Commission, 'Legionnaires' disease, The control of legionella bacteria in water system – Approved Code of Practice and Guidance' issued 2000.

2. Introduction to risk assessment and monitoring

2.1 Systems which are susceptible to colonisation by legionellae, and which incorporate means for creating and disseminating water droplets, should be identified, and the risk they present should be assessed. Risk should be assessed not just for the routine operation or use of the system, but also in unusual circumstances, breakdown, abnormal operation, and commissioning.

2.2 The risk assessment should form the basis of a written operational plan which identifies who has overall accountability for the premises and who is responsible for carrying out the procedures. The plan should contain a detailed schedule of the preventative maintenance procedures.

2.3 Records of risk assessments and implementation of the operational plan should be retained throughout the period for which they remain valid and for at least two years thereafter.

2.4 Details of risk assessment procedures are contained in Section 10 of this part of the SHTM.

3. Operational considerations

Water treatment regimens

3.1 The regimen of water treatment chosen should be agreed by the infection control team (legionella) and the nominated person (legionella). The regimen should be of proven efficacy, and substances and products to be used in contact with potable water supplies must be listed in the current edition of the Water Byelaws Scheme's (WBS) Water Fittings and Materials Directory (WFMD).

3.2 Chemical conditioning systems which are used in conjunction with potable water systems should be selected very carefully. Addition of any substance must not cause a breach of any requirement in the Water Supply (Water Quality) (Scotland) Regulations 1990 and any system for introducing a substance must be listed in the current edition of the WFMD.

3.3 Consideration should be given to whether or not the process kills only the organisms flowing through the equipment (leaving no residual disinfecting agent) or whether disinfecting agents are released into the water circuits.

3.4 To ensure that adequate filtration and/or reverse osmosis is used to provide a pure water supply free of contaminants, chlorine may be used. Ultraviolet (UV), ozone or the release of metal ions are alternative methods of treatment each with specific applications and effectiveness. Further care should be taken in water serving clinical processes, for example dialysis equipment.

3.5 Where process water is to be treated, including cooling towers or water circuits as part of a production process, it is advisable to ensure that the concentration of any chemical treatment is not harmful if the treated water comes into contact with operators or product, and that safe conditions are maintained.

NOTE: Refer to SHTN 2 for detailed information.

3.6 Water treatment systems should be fail-safe and have sufficient instrumentation to monitor their operation. For example, UV systems should incorporate a UV detector so that any loss of transmission can be acted upon immediately.

3.7 Regular (quarterly) inspection and maintenance of water treatment regimens, including records of inspection and testing both of equipment and water quality, should be instituted.

3.8 Hot or cold water delivered to basins and baths should be considered potable and as such, monitored regularly for wholesomeness; the period will normally be quarterly. Where automatic equipment is used for disinfection it should indicate any change in the amount or concentration delivered into the water.

Continuous disinfection of hot and cold water service systems

3.9 The continuous disinfection of hot and cold water service systems to control the growth of legionellae is not usually necessary unless they are suspected to be the source of cases of hospital-acquired legionellae infection.

3.10 Shock disinfection at high concentrations has generally proved to be effective providing that the recommended temperature regimens can be maintained. Where systems are known to be of uncertain quality, however, or where consistent problems of colonisation have been identified, the use of additional water treatment systems may be considered. Such systems should be of proven efficacy, and substances and products to be used in contact with potable water supplies must be listed in the current edition of the Water Byelaws Scheme's (WBS) Water Fittings and Materials Directory (WFMD).

3.11 The biofilm, which can be relatively thick, is not homogeneous, and low concentrations of disinfectant only penetrate the surface.

3.12 After initial disinfection of hot water systems, continuous pasteurisation is recommended by the achievement of adequate operating temperatures.

Frequency of disinfection of hot and cold water service systems

3.13 Disinfection should be undertaken under the following circumstances:

a. new systems prior to handover. If more than seven days elapses before the system is put into regular use, every outlet should be flushed until the water temperature stabilises;

b. existing hot water systems where any part of the calorifier or circulation system has fallen below 45°C;

NOTE: The infection control team should be informed.

c. hot or cold water systems after any modification. This includes new pipework, plus any of the original pipework which may have become contaminated by either extraneous material or biofilm damage. In many cases this will mean the whole system.

3.14 If cold water systems are below 25°C (preferably below 20°C) at all times from meter to outlet, they will probably not need routine disinfection.

3.15 By maintaining the calorifier outlet temperature at greater than 60°C and the temperature everywhere in the circulation system above 50°C, a hot water system is to all intents and purposes "self-pasteurising".

NOTE: The control tolerance must be positive.

3.16 Tanks and calorifiers will need regular draining, cleaning and disinfection. The frequency will depend on site conditions, for example on the build-up of sediment and scale, but should be at least once per year.

Sampling for legionellae

3.17 Routine sampling to detect the presence of legionellae in hot and cold water systems is not recommended. A sampling protocol should be introduced where the systems are suspected to be the source of hospital-acquired legionella infection, or where the infection control team recommends such testing. BS 7592: 1992 'Sampling for Legionellae Organisms in Water and Related Materials' should be referred to. A Public Health Laboratory Service (PHLS) survey has shown that legionellae can be found in most water systems. Wide discrepancies have been found when testing the same water sample for legionellae due to the sampling and analytical procedures.

3.18 Total bacteria counts cannot be used as a risk indicator for the presence of legionellae. However, a sudden increase in counts over and above normal levels or a gradual increase over a period of time, can be indicative of a deterioration in the general water hygiene.

NOTE: Reference should be made to *The Colonisation of Water supplies in United Kingdom Transplant Units with Legionella Bacteria and Protozoa and the risk to patients* – 1995, Published by HEEU ISBN 0-7480-3036-0.

Records/log

3.19 All hot and cold water services should be surveyed to establish conformance with these recommendations. A record should be made and maintained for the systems. "As-fitted" drawings will form an essential element of the record.

3.20 A log should be kept of all actions and checks undertaken in implementation of the recommendations for operation and maintenance.

4. Cold water systems

Water softeners (base exchange)

4.1 Daily or frequent backwashing, and periodic cleaning and disinfection (six-monthly) must be undertaken in accordance with the manufacturer's/supplier's instructions which may require using either chlorine (20 mg/l) or formalin. Other proprietary cleaning agents are not recommended, particularly if the softened supply water serves apparatus such as dialysis units.

Filtration of potable water

4.2 Filtration of potable water to a particle size of 0.2 microns is not uncommon, typically using "dead-end" filters or cross-flow membrane filters.

NOTE: Refer to SHTN 2 for detailed information.

4.3 In all cases it is feasible for bacteria to colonise or "grow through" the filter material even where backwashing is a feature. It is essential for filter cartridge elements to be changed at appropriate intervals in accordance with the manufacturer's recommendations, taking into account local conditions. Filter membranes should also be chemically cleaned or replaced at the recommended periods and care must be taken to ensure that the "vessel" or "housing" containing the filter assembly is also disinfected appropriately during filter or membrane maintenance.

Pressurisation/supply pumps

4.4 Where two or more pumps are installed for pressurising systems, the pumps should be switched daily to ensure that any standby or back-up pump is regularly brought into service as the main duty or lead pump, in order to minimise any danger of stagnation.

Cisterns and tanks

4.5 All cold water storage cisterns and cold feed tanks must be examined, cleaned and disinfected regularly. The frequency will depend on site condition, but should be at least annually and include:

a. isolating the cistern from the mains supply and the distribution pipework. Drain the cisterns;

b. inspecting each cistern (internally and externally), reporting any foreign objects, biological material, excessive corrosion, deterioration or build-up of debris to the nominated person. Then proceed to clean and dry the cistern and carry out any remedial work and/or treatment required as below;

c. refilling with fresh water and disinfecting. Drain and flush the cistern to waste until no disinfectant can be detected;

d. checking operation of ball-valve for shut-off at the correct water level and full discharge flow;

e. refitting cistern cover, securely refastening and ensuring that the screening on pipes open to atmosphere is in place and satisfactory.

NOTE: If chlorine is used it should be to at least 50 mg/l (ppm) free residual chlorine for one hour; other disinfection processes should follow the manufacturer's recommendations.

Internal surfaces of cisterns

4.6 The material of internal surfaces of cisterns should be listed in the WRc Directory of Water Fittings and Materials. After thorough cleaning, but before disinfection, any pitting caused by rust must be cleaned and treated. Care must be taken to ensure that any protective coating is properly air cured after application (as specified in the WRc Directory), with particular regard to the number of days necessary to complete the curing process before refilling with freshwater.

Temperature checks

4.7 The temperature of the cold water service should be checked at least twice a year. The procedure is given in the 'Validation and verification' part of this SHTM. The time of test will usually be:

a. a period of high ambient temperature, probably a warm afternoon;

b. during the winter when heating systems are in use.

Appropriate remedial action should be taken where necessary.

5. Hot water services

Hot water calorifiers

5.1 Calorifiers should be subjected to regular cleaning and maintenance procedures which include the following:

a. quarterly draining to minimise the accumulation of sludge. This frequency may be extended to annual if, during inspection, it is found that there is little accumulation of debris;

b. whenever dismantled, for statutory inspection or every year in the case of water/water calorifiers, calorifiers should be thoroughly cleaned to remove sludge and loose debris (it is not essential to remove all scale);

c. whenever a calorifier is taken out of service, or its flow temperature falls below 45°C for any reason, it should be refilled, drained, refilled again and the entire contents brought up to and held at the nominal operating temperature of 60°C for at least one hour. A calorifier shunt pump will significantly reduce the heat-up time. The calorifier should remain isolated until the procedure is completed. When bringing calorifiers back on line, it is important that service valves are opened **slowly** to avoid any disturbance of sedimented debris. Calorifiers which are to be taken out of service for more than a few days should be drained and should not be refilled until ready for return to service. The drain value should be left open throughout the period the calorifier is out of use;

NOTE: The infection control officer should be informed.

d. users are reminded that if a calorifier is colonised by legionellae and is then drained and opened for maintenance purposes there can be a risk to maintenance personnel of infection;

e. where it is known or established that gross over-capacity exists and where it is practicable to do so, it should be removed.

Hot water circulating pumps

5.2 Circulating pumps should be of adequate performance to ensure a minimum circulation temperature of 50°C.

5.3 In circumstances where it is impracticable to remove pumps (that is, when leaving the standby available for immediate connection into the HWS circulating system) the pumps should be switched daily to ensure that any standby or back-up pump is regularly brought into service as the main duty

or lead pump. It may be more effective to utilise an auto-changeover system, in which case more frequent switching would be appropriate.

5.4 It is not permissible to shut down the pumped circulation system. To do so will lead to the loss of the required system temperatures.

Trace heating

5.5 Electrical trace heating should be checked routinely, at least annually, to ensure that it maintains the water temperature above 50°C. Care should be taken to ensure there are no cool spots.

Temperature checks

5.6 During a period of low ambient temperature, check the temperatures of the outflow from the HWS calorifier to establish that the temperature is above 60°C and that the temperature at the return connection is not less than 50°C. The most distant draw-off point on the system should be checked to ensure that the temperature reaches a steady state value between 60°C and 50°C within one minute of running the water at full flow. Appropriate remedial action should be taken where necessary.

5.7 Although the HSE recommends spot checks, this guidance requires a temperature excursion limit of less than 20 minutes. There should be no more than two excursions in any 24-hour period; therefore, continuous monitoring is recommended.

5.8 Where there is a building management system, it could be used to monitor temperatures within the system.

Showers

5.9 If the guidance contained in this SHTM is followed, it is unnecessary to disinfect shower heads. Earlier recommendations that shower heads should be regularly disinfected, have been withdrawn.

5.10 Hyperchlorination of shower heads and angle valve strainers has only a short-lived effect on legionellae. Automatic drain valves are ineffective in maintaining a reduction in the number of legionellae in shower water. Regular flushing of showers reduces legionellae. The most effective management of showers will be achieved by the removal of unnecessary showers and the regular daily use of others.

6. Evaporative cooling towers

6.1 The HSE require the notification to local authorities of all wet cooling towers and evaporative condensers used in healthcare premises, under the Notification of Cooling Towers and Evaporative Condensers Regulations 1992 (SI 1992/2225).

Water treatment – general

6.2 A water treatment programme is essential for an evaporative cooling system, to restrict corrosion, the build-up of scale and biological contamination. All these factors can cause fouling of the condenser tubes and the pipework distribution system, resulting in poor system efficiency and eventual failure. These factors can also provide an environment which may promote the colonisation and growth of organisms such as legionellae. Continuous automatic water treatment is preferred, particularly where the tower is used intermittently.

6.3 The purpose of this treatment is to prevent deposition of debris on surfaces and to maintain solids in suspension, thus allowing their concentration to be controlled by periodic “blowdown”.

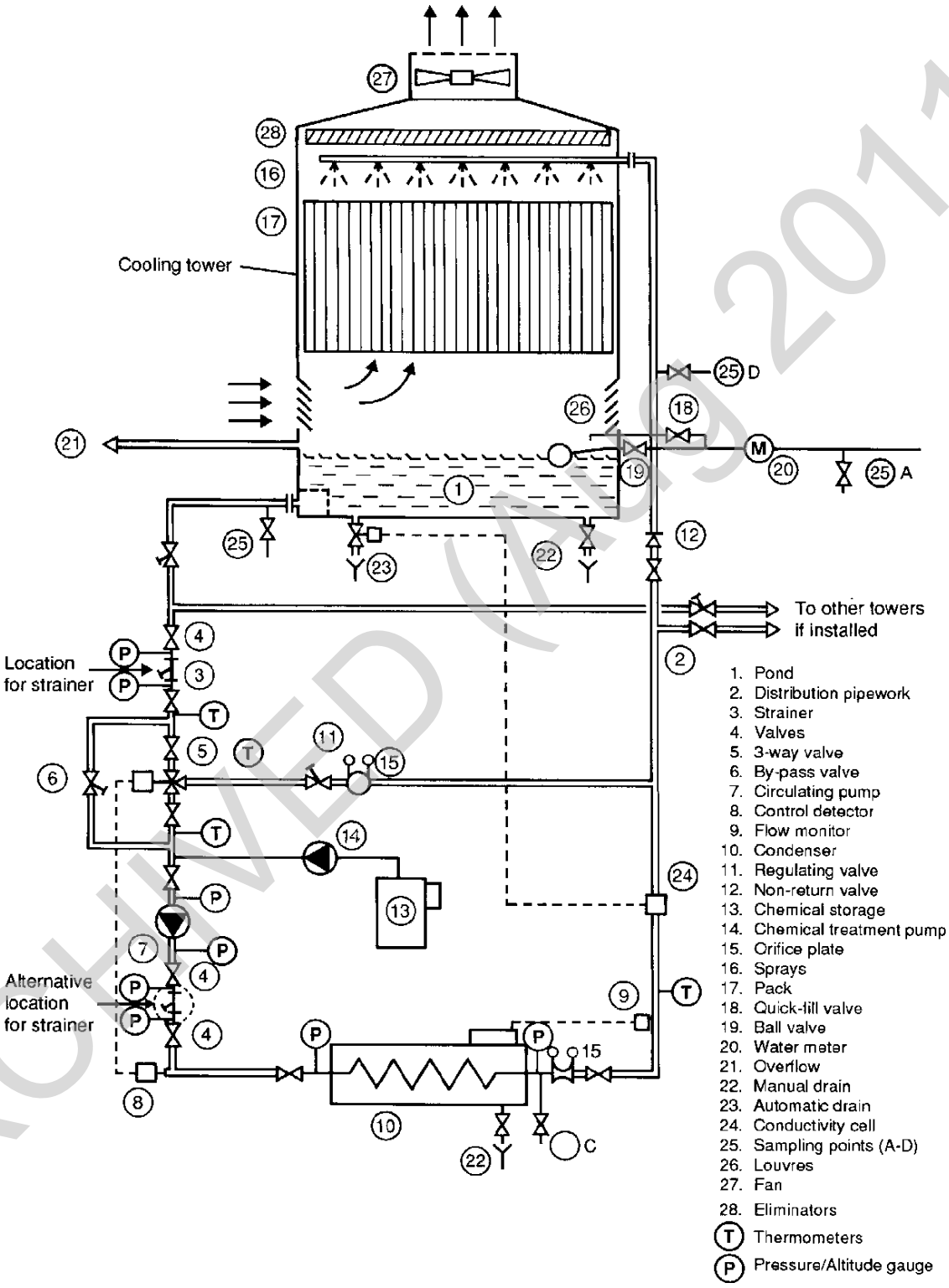
6.4 Before starting any water treatment programme and/or installing equipment the cooling water installation must be completely drained, flushed, chemically cleaned and, finally, thoroughly flushed once again.

6.5 The rate at which contamination accrues or concentrates is dependent on the area and location of the cooling tower, and will differ for industrial, rural or coastal sites.

6.6 The quality and composition of “make-up” water is another factor which has a bearing on the water treatment required.

6.7 Figure 1 shows a typical arrangement for introducing chemicals into the cooling tower circuit. Chemicals are stored in the chemical storage tank (13) and are pumped into the distribution system by the chemical treatment pump (14). One or more dosing system(s) may be required.

Figure 1: Typical cooling tower installation



6.8 The chemicals required to maintain scale and solids in suspension and those required to prevent corrosion must be compatible in all cases. Additionally, where biocides are added, the effectiveness of the chemicals must not be reduced. Specialist water treatment companies will be able to advise on the appropriate regimens. It is essential that the specialist company is made fully aware of the frequency of use of the tower, its capacity, its likely make-up requirements, and also of the use of chlorine donating chemical (sodium or calcium hypochlorite or chloro-isocyanurates) for occasional disinfection; chlorine may not be compatible with all water treatment chemicals. The frequency of visits by the treatment company's operator will be negotiable, but it is advisable to arrange for monthly visits during operation of the cooling system. Some companies provide a simple test kit for measuring the concentration of active treatment chemicals. Test kits should be supplied and instruction in their use obtained from the treatment company so that at least weekly checks can be made by maintenance personnel on site.

6.9 Different companies may advise different levels of total dissolved solids at which action by bleed-off and "make-up" is necessary, and give different optimum levels of total dissolved solids – a typical value is 2000 ppm. A written statement on this, together with details of routine chemical checks, should be sought before any contract is commenced. Information supplied by the company should be readily available for reference. Before checking the treatment chemical concentration following automatic or manual dosing, time should be allowed for circulation and dispersion. Dosing should take place after "blowdown" and fresh water make-up. The telephone number of the company's representative should be kept with the other information so that advice may be sought readily if required. The Sample Logbook in Appendix 4 of the 'Good Practice Guide' shows typical data needed.

6.10 Before entering into a contract, the nature of the treatment chemicals should be discussed with the local water authority who will be able to advise on any concern or necessary precautions in respect of discharge of treated water.

Total dissolved solids (TDS)

6.11 Accurate determination of total dissolved solids (TDS) requires laboratory facilities and may take several hours. The TDS level affects conductivity, however, and a simple conductivity cell may be used for routine testing and to permit automatic control of bleed valves (and make-up).

6.12 Caution is needed when relying on conductivity cells; the relationship between total dissolved solids and conductivity is not constant and is influenced by the treatment chemicals added, the characteristics of the make-up water supply, the type of conductivity testing equipment and the type of dissolved solids present.

6.13 The typical *in-situ* conductivity cell used for the operation of automatic control valves is of necessity robust to withstand water pressures, the varying conditions, damage caused by water-borne debris and the generally hostile environment. The cell consists of two metal electrodes and these may also become coated with deposits; the sensitivity of a cell, therefore, will not be constant. When advice is sought from the specialist company on the appropriate treatment and conditions to be maintained in the circulating system, a specimen of the supply water must be analysed to determine its characteristics and dissolved solids content. The company should be able to advise on the relationship between conductivity and total dissolved solids over the range of conditions likely to be encountered.

6.14 To check the performance of permanently installed conductivity monitors, an accurately calibrated portable test meter is required. Modestly priced, lightweight, battery-operated test meters used by dipping a probe into a sample of pond water are available. They may be obtained calibrated either with a range up to 10,000 TDS in 100 unit intervals, or with a range up to 19,900 $\mu S/cm^2$ (micro-siemens per square centimetre) conductivity. The latter may be more appropriate when the relationship between conductivity and total dissolved solids is not straightforward and a specific conversion factor is required. Most laboratory suppliers can provide these instruments.

Local operational difficulties

6.15 The establishment of formal communication links with both the local distribution manager and water quality scientists of the water authority will ensure that advance plans can be drawn up to cater for any local operational difficulties (either quality or quantity), and that information is available on any local water quality characteristics. Water authorities and local authorities have established joint procedures for dealing with water supply emergencies, and it is important that hospitals are familiar with these arrangements and ensure that the names and contact telephone numbers of these organisations are up-to-date at all times.

Quality assurance

6.16 The current issue of British Standards Institution (BSI) Quality Assessment Schedule QAS/25/253 should be used. It relates to the manufacture and/or supply of water treatment chemicals and plant and the design, specification, supply, monitoring and maintenance of water treatment programmes for building services. The water services within its scope are boiler feed, hot and cold water services, and water used for heating, cooling and air-conditioning.

Maintenance, cleaning and disinfection – general

6.17 This section of the SHTM is intended to assist maintenance staff on the approach towards maintenance, cleaning and disinfection, the work to be carried out and the frequency. Again, it should be seen as a guide only, as it may not cover all aspects which relate to a specific installation. The manufacturers' maintenance documents must be referred to and followed when maintaining any item of plant.

6.18 Work requiring several hours to complete, for example cleaning and disinfection and the associated maintenance tasks, will require careful planning to minimise inconvenience to the user, particularly where standby or dual facilities are not provided.

Maintenance tasks

6.19 Details of the maintenance tasks must be drawn up for a particular site by the nominated person. These, together with the completion of log sheets, will enable a proper historical site record to be compiled of all works carried out and observations made.

6.20 Frequencies are indicated for initial guidance only, as they will vary to suit a particular site, its location, the design parameters and particular principles employed. Those maintenance tasks involving cleaning, removal of debris, painting, etc, should be carried out during cleaning and disinfection of the cooling system.

6.21 As this SHTM describes a typical installation, the maintenance descriptions are not specific but are aimed at identifying the plant, the normal attention and maintenance required and the appropriate frequency. For specific maintenance details such as spares, tools, oil and grease types etc, the manufacturers' maintenance information must be referred to.

6.22 The maintenance tasks listed are based on the typical system shown in Figure 1 and cover each piece of equipment shown.

Cooling towers

6.23 The weekly cleaning of the pond outlet water strainer is not listed as a maintenance task because it has been scheduled as a routine task to be carried out as part of the normal operational checks.

Eliminators *3-monthly*

6.24 Remove eliminators after having first noted their positioning and which side should be uppermost.

6.25 Wipe/brush eliminator blades with a descalant and hose down as necessary to remove any matter. Where algae or slime is present, use 5% solution of sodium hypochlorite. When hosing down, care should be taken not to create aerosols.

6.26 Any tools or equipment used to clean the eliminators must be suitable for the materials used in their construction to ensure no damage is caused.

6.27 Should inspection reveal signs of deposits, scale or other fouling, the application of approved chemicals, with appropriate precautions, is indicated. Advice should be sought on this cleaning process. Fouled eliminators do not necessarily indicate a defective water treatment programme since they are not exposed to the water circulation path and are subject to different conditions.

6.28 Similarly, clean the eliminator mounting frame and inspect for signs of rusting. Clean and make good as necessary. Replace the eliminator sections, taking care to ensure they are the correct way up, properly aligned and sealed so as to ensure their effectiveness.

Sprays or troughs (as applicable) *3-monthly*

6.29 Remove spray nozzles and clean orifice and cone using chemicals where necessary. Do not rely on a visual inspection to assess the need to clean, as fouling of this item is unlikely to be clearly visible. It is essential to maintain an effective spray, otherwise the capacity of the unit will be impaired and scaling of the pack may occur.

6.30 Spray nozzles are usually inserted using grommets. Where a grommet is covered with slime, the material may be one that supports microbiological growth, and it and any similar components should be replaced with a WRc listed alternative.

6.31 Clean spray pipework header and suspension brackets and inspect for corrosion. Repair and make good as necessary.

6.32 Where troughs are used as the water distribution system they must be cleaned to remove any debris or dirt that has collected within them. Care must be taken to ensure that the debris and dirt are not washed into the tower. Removal of the trough to enable careful hosing and wiping will usually suffice.

6.33 Clean the support grid and inspect for signs of rusting; if rusted, clean and make good.

6.34 Replace the trough sections ensuring correct levelling and alignment.

6.35 Check for even water flow and distribution over the pack.

Cooling tower pack and internal maintenance *3-monthly*

6.37 Remove pack sections after noting their position and which side should be uppermost. (This may not be necessary where the pack is symmetrical.)

6.37 Clean pack to remove any fouling. The cleaning method must be appropriate to the pack design and the materials used. Plastic batten packs can often be wiped, brushed or scraped with a non-metallic scraper. Corrugated interlaced plastic packs may require cleaning by a hose, chemical application or purpose-made brushes. In some cases it might be more cost-effective simply to dispose of the pack and replace it. Alternatively and depending on cost, (a) spare pack(s) could be substituted so that the dirty pack(s) can be thoroughly cleaned elsewhere in readiness for future use.

6.38 Should fouling be present it is essential to establish the reasons. Fouling could imply that the water treatment programme and control is suspect, and the water treatment specialist should be called immediately to site.

6.39 Similarly, clean the internal casing of the tower and the pack support grid. Inspect closely for signs of rust and where applicable clean and make good.

6.40 Replace the pack, making sure the sections are installed the correct way up, properly aligned and sealed so as to ensure their effectiveness.

Louvres and screens *3-monthly*

6.41 Brush off any dust, dirt and debris which may have collected on the louvre blades or screen, and wash down. Inspect for signs of rusting and when dry, clean, prepare and make good as necessary.

Pond *3-monthly*

6.42 Isolate the make-up pipe valve and the outflow pipe valve.

6.43 Drain the pond and clean out all the sediment or debris. Washing, light brushing with 5% sodium hypochlorite solution and wiping, paying particular attention to the water line, will usually suffice. Sediment should be flushed away via the drain pipe into the foul water drainage system. Clean the overflow outlet opening and hose through.

6.44 Scrub clean and hose off the strainer screen, and hose away all sediment and debris which may have collected around the outflow pipe orifice. (Note: outflow pipe valve must remain shut.)

6.45 Hose through all drain lines and sampling points to waste.

6.46 When clean, inspect the pan thoroughly for rust or solid deposits. Chemically remove all solid deposits and when dry, clean any rust spots and make good as necessary. Where plastic ponds are installed, the surface should be inspected for integrity.

6.47 Three-monthly cleaning of the pan is essential, as the sediment is often corrosive and can lead to premature failure of the plant.

Ball valve *Weekly*

6.48 Check the operating level of the pond water and adjust the ball valve as necessary.

6-monthly

6.49 Clean the ball valve with 5% sodium hypochlorite solution.

NOTE: The ball valve may be encrusted with scale as well as fouled with organisms. Where scale is present, descaling with proprietary descalant will be necessary – these descalants are bactericidal as a result of their acidic properties and no further treatment will be necessary.

6.50 Change the ball valve washer every six months, since its effectiveness is not easily established under operating conditions.

Yearly

6.51 Examine ball valve float at least annually for leaks and signs of erosion and pitting.

Immersion heater and trace heating *6-monthly*

6.52 Operational checks will establish whether or not the immersion heater or trace heating tapes have failed. If so, they should be replaced.

6.53 Check the integrity of electrical installation and the thermal insulation systems' weatherproofing, and make good as necessary.

6.54 Operational control of cooling tower immersion heaters should be checked to avoid their continued function in mild weather or when the pond has been drained.

Distribution system and equipment

6.55 This section of SHTM 2040 is primarily concerned with reducing the risks associated with legionella. Maintenance to ensure mechanical efficiency of, for example, motor bearings and cooling vents, will also be essential. Such tasks can be added to the appropriate log sheets in accordance with the manufacturer's maintenance recommendations.

6.56 General guidance on plant maintenance:

a. valves:

6-monthly

(i) clean dust or deposits from all valve spindles. Operate valves through full open/closed positions and reset to original position (care must be taken to reset regulating valves, and it is recommended that where facilities are available a manometer be used to check design flow against the commissioning data);

6-monthly

(ii) adjust gland nuts as required;

As necessary

(iii) replace gland packing as required;

6-monthly

(iv) carry out any valve lubrication as recommended by the manufacturers;

b. strainer:

6-monthly

(i) isolate strainer, remove basket and clean inside of strainer body. Insert spare strainer basket and put system back on line. Remove contents of the strainer basket taken out of pipeline and brush in a bucket of 5% sodium hypochlorite solution to release any slimes which may be difficult to detect visually. When clean, place basket adjacent to strainer as spare ready for next servicing;

c. 3-way control valve:

6-monthly

(i) check valve spindle for signs of wear and distortion;

(ii) replace as necessary;

6-monthly

(iii) check gland nuts and adjust as necessary;

As necessary

(iv) remove valve body and inspect seat and plug for signs of scouring, wear and deposits. Clean physically or chemically as necessary, or replace if need be;

(v) re-assemble valve, test and leave in working order;

d. inspection covers:

Yearly

(i) remove inspection covers when the system is drained and assess the internal condition of the pipework. Note any scaling or fouling and, if necessary, consult the water treatment specialist;

e. automatic air vents:

6-monthly

(i) isolate, remove float and clean inside of AAV bottle and ports. Blow through discharge line to ensure line is clear;

(ii) clean float and needles and inspect carefully for signs of puncture or erosion, and exchange if necessary. Replace float, commission valve and leave in working order;

f. circulating pumps:

Monthly

(i) clean impeller shaft;

As necessary

(ii) lubricate all thrust and collar bearings to frequency advised by manufacturer;

Monthly

(iii) check belts for correct tension and alignment, and adjust as required;

Monthly

(iv) clean belt guard and make good any corroded parts. Refit, adjust align and tighten bolt assembly;

Monthly

(v) adjust anti-vibration mountings as may be necessary and tighten all bed plate fixings. Replace any rusted bolts;

Monthly

(vi) check pump glands and adjust as necessary. Replace glands where the drip rate is excessive;

Monthly

(vii) wipe clean drip cups and test drip line by pouring fluid into cup. Where necessary, rod through;

Yearly

(viii) dismantle impeller casing, inspect impeller for signs of wear, and clean;

(ix) replace where necessary;

g. pressure gauges:

Yearly

(i) service pressure and altitude gauges to manufacturers' recommendations or alternatively, exchange for recommissioned and re-calibrated units;

h. condenser:

Yearly

(i) isolate and drain condenser. Remove end plates and clean off tube plates. Rod through the tubes with manufacturers' rodding brush. Treat any corrosion on the tube plates and covers with WRc approved materials, and replace;

i. sample points:

6-monthly

(i) operate sample points to ensure discharge lines are clear. Pour effluent collected into foul water drainage system. Service valves or cocks;

j. flow monitor:

6-monthly

(i) remove flow monitor and inspect paddle and linkage. Some chemical cleaning may be required. If paddle does not operate freely, discard and replace;

k. non-return valve:

6-monthly

(i) clean clack and seat. If clack disc shows signs of scouring or erosion, renew disc and re-assemble valve;

l. conductivity cell:

6-monthly

(i) when system is drained, remove conductivity cell and carry out cleaning and maintenance as recommended by the instrument manufacturer;

m. dosing pump(s):

Monthly

(i) inspect pump and lubricate any bearings as recommended by the pump manufacturer. Such pumps are “micro-pumps” and may have bearings sealed for life; if so, they may be discarded after reasonable life has been achieved (operational testing will identify poor performance);

n. thermometers:

Monthly

(i) wipe clean mercury in glass thermometer to ensure clear visibility of mercury column;

6-monthly

(ii) check thermo-conductivity paste within;

Yearly

(iii) check thermometer pockets and replenish where necessary. Remove pocket from pipeline and clean the parts immersed in the pipeline. Where fouling is present, use chemical cleaning agents to remove fouling; flush and re-install;

o. fan blades:

3-monthly

(i) check and clean.

Cleaning and disinfection

6.57 Cleaning and disinfection should not be confused with regular chemical water treatment. A regular water treatment programme is required to control corrosion, algae, slime and scale, etc; cleaning and disinfection of the entire system is required on a routine basis to eliminate any micro-organisms which may be present in the system.

6.58 The cooling tower, the distribution system and any tanked water make-up system must be cleaned and disinfected with chlorine or other suitable disinfectant. Additionally, unless continuous automatic disinfection is used, the process must be repeated should the system be shut down for any period of five days or more, or should there be cause to suspect a build-up of biological material which might contain *Legionella pneumophila*.

3-monthly

6.59 Where a cooling tower is only used seasonally, it should be cleaned before start up, mid-way through, and at the end of the cooling season. After final cleaning, cooling towers should be left “dry”.

NOTE: Protective covers over the louvres etc, may be necessary.

6.60 For plant operated continuously throughout the year it may be possible to reduce the frequency of cleaning to twice yearly. When the frequency is reduced, however, the water quality should be carefully monitored and exposure of all parts of the cooling water system to the regular water treatment should be ensured, particularly in the winter under part-load conditions for the cooling tower.

6.61 The method of cleaning is covered under “Cleaning and disinfection procedures” below and should be recorded on the appropriate log sheet.

7. Cleaning and disinfection procedures

General

7.1 This section covers cleaning and disinfection of the cooling tower and distribution systems and, where applicable, the make-up systems when fed from a tanked supply.

7.2 Cleaning and disinfection must be carried out:

a. prior to initial commissioning and bringing into use after installation;

b. (i) **for short "cooling season" operation.** In such cases the cooling tower should be cleaned before start-up, mid-way through, and at the end of the cooling season. After final cleaning, cooling towers should be left "dry" throughout the winter months;

(ii) **for continuous operation throughout the year.** It may be possible to reduce the frequency of cleaning to twice yearly. When the frequency is reduced, however, the water quality should be carefully monitored and exposure of all parts of the cooling water system to the regular water treatment should be ensured, particularly in the winter under part-load conditions for the cooling tower;

c. after a shutdown period of five days or more unless there is continuous automatic disinfection;

d. if the system or part of it has been altered or otherwise disturbed;

e. whenever the "cleanliness" of the system is in doubt.

7.3 The water treatment programme will control the water conditions so that they are unfavourable to the proliferation of micro-organisms.

7.4 When carrying out cleaning and disinfection it is essential that the entire system, including any feed tank, is treated, since it would be pointless to clean the cooling tower and condenser pipework distribution system only to refill the system with water from a contaminated make-up tank. Similarly, all towers in an installation should be cleaned on the same occasion so that no cross-contamination occurs.

The cleaning and disinfection process

7.5 When the cooling towers are fed from a high-level make-up tank, clean and disinfect the tank and the feed line first, before allowing it to drain into the towers. Next, clean and disinfect the entire condenser water cooling system.

Bring the system back into commission by filling, via the make-up tank, with treated water.

7.6 The following method of cleaning and disinfection must be employed:

a. switch off and isolate all plant, including water treatment controls and monitors, except the circulating pump which will be required to operate during the cleaning procedure;

b. dose the water with sodium hypochlorite to obtain a minimum free residual chlorine concentration in the water of 5 mg/l (ppm). In normal circumstances the initial dose will have to be in the order of 5-15 mg/l, higher doses being essential when the pH exceeds 8.0 and the level of total dissolved solids and water temperature are elevated. The water should be circulated throughout the system for a minimum of 6 hours to ensure a minimum concentration of 20 to 30 mg/l/hours. Ensure circulation occurs through the system bypass line, the 3-way control valve maintenance bypass and any standby plant, etc;

c. chemical dispersants may be necessary to remove the organic material which builds up in cooling water system pipework. Ensure again that circulation occurs through the entire system;

d. drain the contents of the cooling tower pond;

e. (i) for installations where towers are fed from a separate feed tank, isolate feed to the cooling tower make-up tank and drain the tank of its contents. Isolate the feed line from this tank to the cooling tower;

(ii) fill the make-up tank with fresh water, and add sodium hypochlorite to the water in the make-up tank to give a free residual concentration in excess of 5 mg/l in the tank water. Open the valve in the feed line to the cooling tower so as to fill the feed line with chlorinated water, and then close this line by operation of the stop valve adjacent to cooling ball valve. Allow the system to stand for one hour, then sample the water from the tower ball valve and check that the free residual chlorine level remains above 5 mg/l;

NOTE: The dose required to achieve a free residual concentration of 5 mg/l after 1 hour's contact will depend on pH, the water temperature and the presence in the water of either ammonia or chlorine.

f. drain the entire contents of the condenser water distribution system;

g. carry out the cleaning and maintenance tasks as recommended in the maintenance section. The work sequence must be from the top of the tower downwards. Re-assemble the tower;

h. when the physical cleaning and maintenance process is complete and the tower re-assembled, the system should be refilled with fresh water and the water re-chlorinated to maintain a free residual chlorine level of not less than 5 mg/l. The water should then be circulated for 4-6 hours,

with the residual chlorine maintained at this level throughout this period, after which the entire system should be drained;

i. at this stage, the system is ready to be brought into commission. If the design requirement is for the system to operate using softened water via the make-up tank or a direct treated water supply, the system must be drained again to enable filling with treated water if a separate supply of untreated water has been used for filling and flushing out. At the same time the controls to the water treatment dosing and monitoring equipment should be energised. It should be noted that if any of the chemical dosing systems is controlled by a time switch this should be set so as to ensure dosing of the initial fill. The dosing system should then be thoroughly primed before being put to use.

NOTE: Foaming may result from particular additives or from mechanical agitation. Chemical foaming may be avoided by using different chemicals, chemicals with anti-foaming agents, or by adding agents to disperse foam which has formed.

7.7 A proprietary solution of sodium hypochlorite is recommended rather than slow-releasing tablets. Disinfectants other than chlorine may be adopted for disinfection, in accordance with manufacturer's instructions, provided the objectives of safe, effective disinfection are achieved.

7.8 The application of solutions containing disinfectant to a water system containing biological material may result in foaming of the water. If foaming occurs on dosing or during circulation of the water being treated, it is advisable to drain the system of water and repeat the procedure with a lower dose of disinfectant. The procedure should be repeated using one-hour circulation times, gradually increasing the dose until it is possible to carry out the procedure outlined in paragraph 7.6 (b) above without the generation of foam on the surface of the pond water.

7.9 High concentrations of chlorine may bleach reagents used in test kits. If a negative or low reading is obtained in stage (b) above (paragraph 7.6), it is important to check the validity of the result by repeating the test using a sample of the water diluted with fresh water. At levels below 200 mg/l, however, there should be no difficulty in interpreting results.

7.10 To ensure the correct dosing level, a good quality test kit will be required.

7.11 Normal protective clothing is all that is needed for inspection, treatment and cleaning operations not requiring the use of a high-pressure water spray or other methods generating a similar aerosol. In circumstances where the use of a high-pressure water spray is essential, the Health and Safety Executive recommends the use of special clothing and positive pressure respirators.

7.12 Contaminated water that is run to waste into a natural watercourse or a drain leading to it should be treated in accordance with the requirements of the

authority responsible for land drainage and pollution control. The authority responsible for that sewer should be informed. Dechlorination can be achieved using either sulphur dioxide or sodium thiosulphate. 20 g of sodium thiosulphate crystals are required to dechlorinate 500 litres of water containing 20 mg/l free chlorine.

Re-assessment of existing installation

7.13 This section of the SHTM is intended to guide the user in assessing an existing installation, and in judging the effectiveness of the installation and the degree of risk in respect of *Legionella pneumophila*.

7.14 To assist in this assessment, a series of critical questions should be answered by the user. The questions are grouped for convenience – see Part 1 Appendix 1 of this SHTM. A decision to renew or replace, however, will depend on the number and severity of the identified problems.

7.15 Where it is concluded that the system needs to be replaced, it is recommended that a non-evaporative heat rejection system, employing equipment such as air-cooled condensers, be installed.

7.16 The questionnaire is intended to act as a guide; other considerations such as the life of the plant, the design conditions, size of the plant and space available, etc, will also be significant in determining when the plant should be replaced and by what means.

8. Air-conditioning and mechanical ventilation

General

8.1 Air-conditioning and ventilation plant and ductwork should be inspected to see that it is clean and to report on its general condition. After several years in service, even in the case of a correctly filtered plant, there may be signs of dirt accumulation, and consideration should be given to cleansing the system. Accumulation of dirt in a relatively short period is indicative either of a failure of the filtration system or that the wrong filters are being used. In particularly polluted areas, it may be appropriate to consider the installation of a higher grade of filter as well as a pre-filter. The quality of filter housing and, in particular, the seals is a critical factor in maintaining the efficacy of the filtration system by ensuring that air does not bypass the filter panels.

Fresh air inlet

8.2 In the case of existing installations the use of portable smoke generators or smoke bombs may be helpful in visualising the discharge plume from cooling towers and discharges from extract systems in order to assess any potential risk.

NOTE: The wind conditions will vary from day to day and sufficient tests to provide a representative sample will be necessary. The tests should be repeated with the cooling tower fan(s) both on and off.

Cooling/chiller coils

8.3 Cooling/chiller coils precipitate water by condensing the vapour present in the air. This will occur during “sensible” cooling as well as during dehumidification. It is good practice to fit downstream eliminator plates. Consideration should be given to installing downstream eliminator plates in existing plant.

Humidifiers

8.4 If the humidifier is not to be used for an appreciable period of time, it and any break tank should be drained down, either manually or automatically, and left empty. Existing capillary cell humidifiers or systems which rely on recirculated water, for example spray coil systems, should be taken out of service or replaced.

8.5 The cleanliness of the water supply and the effectiveness of any water treatment regimen should be regularly checked to a procedure agreed by the infection control team. The addition of treatment chemicals for continuous control of water quality for humidifiers/air handling units should be avoided. Consideration could be given to installing a UV system to control microbiological growth. UV systems, however, rely on high quality filtration to ensure the effective exposure of micro-organisms to the UV irradiation. The performance of the filter and the UV detection system should be regularly checked.

8.6 Internal surfaces likely to be wetted should be regularly inspected. In the event of fouling, specialist cleaning may be necessary.

8.7 Providing the water supply is suitable, existing spinning disc humidifiers may be retained in service. Spinning disc humidifiers are known to present a considerable risk of causing humidifier fever once contaminated, and require to be kept clean and well maintained.

8.8 The frequencies utilised in ultrasonic humidifiers cannot be considered as effective for the control of micro-organisms. The supply of water to the humidifier should be free from viable bacteria. Regular inspection and cleaning is required.

8.9 There should be a clear statement of the microbiological and chemical COSHH assessment of the operation of all humidifiers, water treatment regimens and monitoring procedures.

8.10 The procedures should be detailed in both the operating and maintenance manuals produced for each plant.

Drainage traps

8.11 Traps should be checked monthly to ensure that the water level is correct.

Portable/room humidifiers

8.12 Portable/room humidifiers should be subjected to a regular and effective maintenance regimen, approved by the control of infection team and determined with the manufacturer.

9. Other operational considerations

Hydrotherapy pools, whirlpool baths and spas

9.1 Hydrotherapy pools, whirlpool baths and whirlpool spas provide conditions which potentially favour the growth of legionella. While there have been no reported cases of legionella infection implicating hydrotherapy pools, there have been several outbreaks associated with spa pools or whirlpools. These are particularly vulnerable because of the small volume of water in circulation and the multi-occupancy (typically 3-6 persons). Careful maintenance and chemical treatment is essential to maintain water quality. A log must be kept of the treatment, filter cleaning and the results of tests for pH, free residual halogen and other treatment parameters.

9.2 Spa baths and whirlpool baths which provide a single fill for each individual use do not appear to present the same hazard. There remains concern, however, about retention of water in these systems; an International Standard to cover this subject is proposed.

9.3 Regular cleanings and periodic disinfection in accordance with manufacturers' instructions is recommended.

9.4 The Swimming Pool and Allied Trades Association (SPATA) will provide advice on the operation of whirlpool spas.

9.5 Advice on the operation of hydrotherapy pools is contained in 'Department of Rehabilitation, a Design Guide', published by the DHSS in 1974. More recent information is contained in: The Central Sterilizing Club, Hygiene for Hydrotherapy Pools, published in 1990; Hygiene for Spa Pools – Guidelines For their Safe operation – PHLS Spa Pool Working Party 1994 ISBN 0901144371. Pseudomonas Aeruginosa in Whirlpool Baths issued by the HEEU 11-7-97.

Temporary closure of wards/departments

9.6 During temporary closure of wards or departments, a procedure for flushing the hot and cold water service systems should be instituted.

9.7 This should include opening all taps for a period of three minutes and flushing WC cisterns, etc, on a weekly cycle. Alternatively, when this is impracticable, the disinfection procedure recommended for new installations may be carried out immediately prior to occupation.

10. Risk assessment

General

10.1 The risk assessment should take account of:

a. the potential for aerosol formation;

b. water temperature;

c. means of preventing or controlling the risk;

d. the likely risk to those who will inhale water droplets. In practice, for healthcare organisations, the susceptibility of the population exposed to legionellae can be subdivided into three categories:

(i) high risk – see volume 2 of this SHTM, 'Design considerations', Chapter 3;

(ii) moderate risk – other healthcare premises;

(iii) low risk – non-healthcare premises, for example ambulance stations, office blocks.

10.2 Risk assessments should follow the strategy outlined in the "management checklist" contained in Appendix 1 of 'Overview and management responsibilities' Part 1 of this SHTM. The assessment should involve an on-site survey of each system, and should be fully documented.

10.3 A re-assessment should be undertaken whenever there are modifications to the operation or configuration of the system.

10.4 Water testing for the presence of legionellae cannot form the basis of legionellosis risk assessment.

Records

10.5 Records are required of:

a. the name and position of the person(s) appointed as nominated person and infection control team;

b. the risk assessment;

c. the name and position of the person(s) who conducted the risk assessment;

d. the management plan for minimising the risk from exposure to legionellae;

e. the name and position of the persons who have responsibilities in implementing the scheme, what their responsibilities are, and their lines of communication;

f. records showing when the plant is in use and, if not in use whether it is drained down.

10.6 Records should be kept of the written operational plan, showing:

a. details of precautionary measures carried out, in sufficient detail to show that they were carried out correctly and the dates on which they were carried out;

b. dates and results of inspections, tests, checks;

c. remedial work required and carried out, with date of completion.

These entries should bear the signature of the person carrying out the task, or other form of authentication.

References

NOTE:
Where there is a requirement to address a listed reference, care should be taken to ensure that all amendments following the date of issue are included.

Publication ID	*Title*	*Publisher*	*Date*	*Notes*
Acts and Regulations				
	The Building (Scotland) Act	HMSO	1959	
	Clean Air Act	HMSO	1993	
	Consumer Protection Act	HMSO	1987	
	Electricity Act	HMSO	1989	
	The Food Safety Act	HMSO	1990	
	Registered Establishments (Scotland) Act	HMSO	1998	
	The Water (Scotland) Act	HMSO	1980	
	Health and Safety at Work etc Act	HMSO	1974	
SI 346	The Active Implantable Medical Devices Regulations	HMSO	1992	
SI 2179 & 187	The Building Standards (Scotland) Regulations	HMSO	1990	
	The Building Standards (Scotland) Regulations: Technical Standards Guidance	HMSO	1998	
SI 1460	Chemicals (Hazard Information and Packaging for Supply) Regulations (CHIP2)	HMSO	1997	
SI 3140	Construction (Design and Management) Regulations	HMSO	1994	
SI 437	Control of Substances Hazardous to Health Regulations (COSHH)	HMSO	1999	
SI 635	Electricity at Work Regulations	HMSO	1989	
SI 1057	Electricity Supply Regulations	HMSO	1988 (amd 1990)	
SI 3080	Electromagnetic Compatibility (Amendment) Regulations	HMSO	1994	
SI 2372	Electromagnetic Compatibility Regulations	HMSO	1992	

Publication ID	Title	Publisher	Date	Notes
	Food Safety (Temperature Control) Regulations	HMSO	1995	
	Food Safety (General Food Hygiene) Regulations	HSMO	1995	
SI 2451	Gas Safety (Installation and Use) Regulations	HMSO	1998	
SI 917	Health & Safety (First Aid) Regulations	HMSO	1981	
SI 682	Health & Safety (Information for Employees) Regulations	HMSO	1989	
SI 2792	Health and Safety (Display Screen Equipment) Regulations	HMSO	1992	
SI 341	Health and Safety (Safety Signs and Signals) Regulations	HMSO	1996	
SI 1380	Health and Safety (Training for Employment) Regulations	HMSO	1990	
SI 2307	Lifting Operations and Lifting Equipment Regulations (LOLER)	HMSO	1998	
SI 3242	Management of Health and Safety at Work Regulations	HMSO	1999	
SI 2793	Manual Handling Operations Regulations	HMSO	1992	
SI 3017	The Medical Devices Regulations	HMSO	1994	
SI 1790	Noise at Work Regulations	HMSO	1989	
SI 2225	The Notification of Cooling Towers and Evaporative Condensers Regulations	HMSO	1992	
SI 3139	Personal Protective Equipment (EC Directive) Regulations	HMSO	1992	
SI 2966	Personal Protective Equipment at Work (PPE) Regulations	HMSO	1992	
SI 2169	The Pressure Systems and Transportable Gas Containers Regulations	HMSO	1989	
SI 574	The Private Water Supplies (Scotland) Regulations	HMSO	1992	
	The Public Health (Notification of Infectious Disease) (Scotland) Regulation	HMSO	1988	
	The Public Health Act (Infectious Disease) Regulations	HMSO	1975	
SI 2306	Provision and Use of Work Equipment Regulations (PUWER)	HMSO	1998	

Publication ID	*Title*	*Publisher*	*Date*	*Notes*
SI 3163	Reporting of Injuries, Diseases and Dangerous Occurrences Regulations (RIDDOR)	HMSO	1995	
SI 1333	The Water Supply (Water Quality) (Scotland) Regulations (amendment)	HMSO	1991	
SI 3004	Workplace (Health, Safety and Welfare) Regulations	HMSO	1992	
British Standards				
BS 6700	Specification for design, installation, testing and maintenance services supplying water for domestic use within buildings and their curtilages	BSI Standards	1997	
BS 7206	Specification for unvented hot water storage units and packages	BSI Standards	1990 (1997)	
BS 6920	Suitability of non-metallic products for use in contact with water intended for human consumption with regard to their effect on water quality	BSI Standards	1996	
BS 7592	Sampling for Legionellae organisms in water and related materials	BSI Standards	1992	
European Union Directives				
80/778/EEC	The Quality of Water Intended for Human Consumption	EEC		
Scottish Health Technical Guidance				
SHTM 2005	Building management systems	EEF	1999	CD-ROM
SHTM 2023	Access and accommodation for engineering services	EEF	1999	CD-ROM
SHTM 2024	Lifts	EEF	1999	CD-ROM
SHTM 2025	Ventilation in healthcare premises	EEF	1999	CD-ROM
SHTM 2027	Hot and cold water supply, storage and mains services	EEF	1999	CD-ROM
SHGN	'Safe' hot water and surface temperatures	EEF	1999	CD-ROM
SHPN 1	Health service building in Scotland	HMSO	1991	
SHPN 2	Hospital briefing and operational policy	HMSO	1993	
SHTN 1	Post commissioning documentation for health buildings in Scotland	HMSO	1993	
SHTN 2	Domestic hot and cold water systems for Scottish Health Care Premises	EEF	1999	CD-ROM
SHTN 4	General Purposes Estates and Functions Model Safety Permit-to-work Systems	EEF	1997	

Publication ID	*Title*	*Publisher*	*Date*	*Notes*
	NHS in Scotland – Scotconcode Scottish Infection Manual: Guidance on core standards for the control of infection in hospitals, healthcare premises and at the community interface	EEF	1999	Version 3
NHS in Scotland Firecode				
HTM 81	Fire precautions in new hospitals	EEF	1998	CD-ROM
HTM 82	Alarm and detection systems	EEF	1998	CD-ROM
HTM 83	Fire safety in healthcare premises: general fire precautions	EEF	1998	CD-ROM
HTM 84	Fire safety in NHS residential care properties	EEF	1998	CD-ROM
HTM 85	Fire precautions in existing hospitals	EEF	1998	CD-ROM
HTM 86	Fire risk assessment in hospitals	EEF	1998	CD-ROM
HTM 87	Textiles and furniture	EEF	1998	CD-ROM
Fire Practice Note 3	Escape bed lifts	EEF	1998	CD-ROM
Fire Practice Note 4	Hospital main kitchens	EEF	1998	CD-ROM
Fire Practice Note 5	Commercial enterprises on hospital premises	EEF	1998	CD-ROM
Fire Practice Note 6	Arson prevention and control in NHS healthcare premises	EEF	1998	CD-ROM
Fire Practice Note 7	Fire precautions in patient hotels	EEF	1998	CD-ROM
Fire Practice Note 10	Laboratories on hospital premises	EEF	1998	CD-ROM
UK Health Technical Guidance				
EH 40	HSE Occupational Exposure limits	HSE	Annual	
MES	Model Engineering Specifications	NHS Estates	1997	As required
	The colonisation of water in United Kingdom transplant units with Legionella bacteria and Protozoa and the risk to patients	HEEU	1995	
	Pseudomonas Aeruginosa in whirlpool baths	HEEU	1997	

Publication ID	*Title*	*Publisher*	*Date*	*Notes*
Public Health Laboratory Services				
	Spa pool working party	PHLS	1994	
	Hygiene for hydrotherapy pools	PHLS	1990	
	Hygiene for spa pools: guidance for their safe operation	PHLS		
Miscellaneous References				
	Model Water Byelaws: Dept. of the Environment	HMSO	1986	
	Chemical Disinfection in Hospitals (second edition)	PHLS	1993	
	Water Byelaws Scheme's (WBS) Water Fittings and Materials Directory (WFMD).			
	Department of rehabilitation: a design guide	DHSS	1974	
	The central sterilization club, hygiene for hydrotherapy pools	PHLS	1990	
	A guide to pre-commission cleaning of water systems	BSRIA	1991	