

**Scottish Health Technical Memorandum
04-01**
Water safety for healthcare premises
Part B: Operational management

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Disclaimer

The contents of this document are provided by way of general guidance only at the time of its publication. Any party making any use thereof or placing any reliance thereon shall do so only upon exercise of that party's own judgement as to the adequacy of the contents in the particular circumstances of its use and application. No warranty is given as to the accuracy, relevance or completeness of the contents of this document and Health Facilities Scotland, a Division of NHS National Services Scotland, shall have no responsibility for any errors in or omissions therefrom, or any use made of, or reliance placed upon, any of the contents of this document.

Acknowledgements

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HTM 04-01 Part B has been updated and amended by Health Facilities Scotland for use in NHSScotland as SHTM 04-01 Part B. The document has now been updated to reflect experience in use and recent guidance on harmful pathogens and re-titled 'Water safety for healthcare premises'. The significant participation of the National Water Services Advisory Group is gratefully acknowledged.

Note: This version (2.0) of SHTM 04-01 Part B has been updated to take account of latest guidance forthcoming regarding measures to prevent build-up of waterborne bacteria and biofilm such as *Pseudomonas* as it affects design and specification of domestic hot and cold water systems and components. (Note 4 and paragraphs 1.1, 5.6, 7.30 and 7.39 together with new paragraphs 5.28 – 5.30 refer).

Preface

About Scottish Health Technical Memoranda

Engineering Scottish Health Technical Memoranda (SHTMs) give comprehensive advice and guidance on the design, installation and operation of specialised building and engineering technology used in the delivery of healthcare.

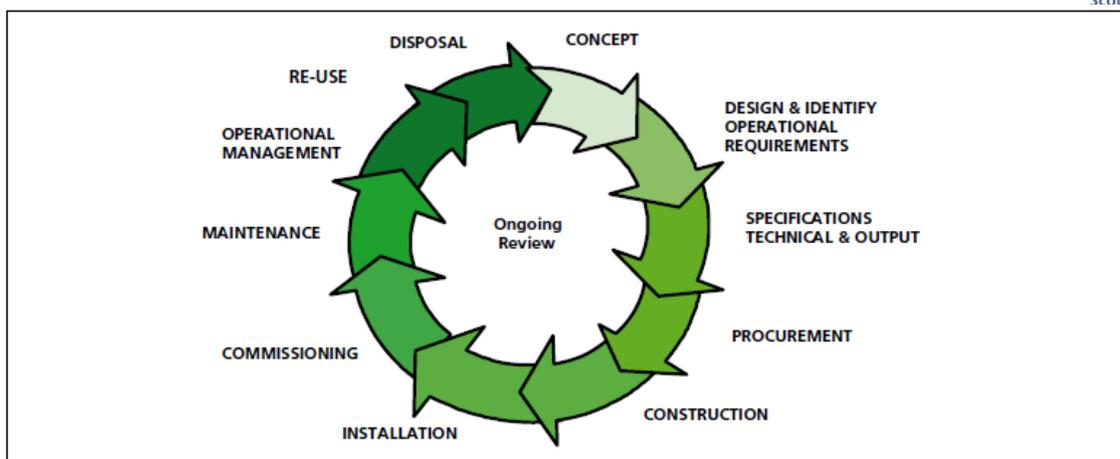
The focus of SHTM guidance remains on healthcare-specific elements of standards, policies and up-to-date established best practice. They are applicable to new and existing sites, and are for use at various stages during the whole building lifecycle: Healthcare providers have a duty of care to ensure that appropriate engineering governance arrangements are in place and are managed effectively. The Engineering Scottish Health Technical Memorandum series provides best practice engineering standards and policy to enable management of this duty of care.

It is not the intention within this suite of documents to repeat unnecessarily international or European standards, industry standards or UK Government legislation. Where appropriate, these will be referenced.

Healthcare-specific technical engineering guidance is a vital tool in the safe and efficient operation of healthcare facilities. Scottish Health Technical Memorandum guidance is the main source of specific healthcare-related guidance for estates and facilities professionals.

The core suite of eight subject areas provides access to guidance which:

- is more streamlined and accessible;
- encapsulates the latest standards and best practice in healthcare engineering;
- provides a structured reference for healthcare engineering.



Healthcare building life-cycle

Structure of the Scottish Health Technical Memorandum suite

The series of engineering-specific guidance contains a suite of eight core subjects:

Scottish Health Technical Memorandum 00: Policies and principles (applicable to all Scottish Health Technical Memoranda in this series)

Scottish Health Technical Memorandum 01: Decontamination

Scottish Health Technical Memorandum 02: Medical gases

Scottish Health Technical Memorandum 03: Heating and ventilation systems

Scottish Health Technical Memorandum 04: Water systems

Scottish Health Technical Memorandum 05: Reserved for future use

Scottish Health Technical Memorandum 06: Electrical services

Scottish Health Technical Memorandum 07: Environment and sustainability

Scottish Health Technical Memorandum 08: Specialist services

Some subject areas may be further developed into topics shown as -01, -02 etc and further referenced into Parts A, B etc.

Example: Scottish Health Technical Memorandum 06-02 Part A will represent: Electrical safety guidance for low voltage systems

In a similar way Scottish Health Technical Memorandum 07-02 will simply represent: Environment and Sustainability – EnCO₂de.

All Scottish Health Technical Memoranda are supported by the initial document Scottish Health Technical Memorandum 00 which embraces the management and operational policies from previous documents and explores risk management issues.

Some variation in style and structure is reflected by the topic and approach of the different review working groups.

Health Facilities Scotland wishes to acknowledge the contribution made by professional bodies, engineering consultants, healthcare specialists and NHS staff who have contributed to the review.



Engineering guidance structure

Executive summary

Preamble

Scottish Health Technical Memorandum 2027: 'Hot and cold water supply, storage and mains services' and Scottish Health Technical Memorandum 2040: 'The control of *Legionella* in healthcare premises: a code of practice' have both been revised, and have, at the same time, been combined into this single document: Scottish Health Technical Memorandum 04-01: 'Water safety for healthcare premises'.

The guidance has been revised in line with changes to relevant regulations, standards and other guidance, and also technical developments.

Introduction

The development, construction, installation and maintenance of hot and cold water supply systems are vital for public health. Healthcare premises are dependent upon water to maintain hygiene and a comfortable environment for patients and staff, and for clinical and surgical care.

Interruptions in water supply can disrupt healthcare activities. The design of systems must ensure that sufficient reserve water storage is available to minimise the consequence of disruption, while at the same time ensuring an adequate turnover of water to prevent stagnation in storage vessels and distribution systems.

This Scottish Health Technical Memorandum gives comprehensive advice and guidance to healthcare management, design engineers, estate managers and operations managers on the legal requirements, design applications, maintenance and operation of hot and cold water supply, storage and distribution systems in all types of healthcare premises. It is equally applicable to both new and existing sites.

Aims of this guidance

This guidance has been written to:

- provide information on thermostatic mixing valve configurations, usage and maintenance requirements;
- outline how quality and hygiene of water supply can preserve system components and safe use by occupants;
- provide a point of reference to legislation, standards and other guidance pertaining to water systems;
- provide a basic overview of possible bacterial contaminants;

- outline key criteria and system arrangements to help stop bacteria proliferate;
- give an overview of some of the different water systems components and their safe installation and operation;
- provide typical system layouts and individual component location;
- illustrate the importance of 'safe' delivery of hot water;
- illustrate temperature regimes for sanitary outlets used in healthcare premises to reduce risk of occupant injury;
- identify key commissioning, testing and maintenance requirements for referral by designers, installers, operators and management.

Recommendations of Part B

The temperature control regime is the preferred strategy for reducing the risk from *Legionella* and other waterborne organisms in water systems. This will require monitoring on a regular basis. The recommended test frequencies are listed below.

Frequency	Check	Cold water	Hot water	Notes
Monthly	Sentinel outlets	The water temperature should equilibrate below 20°C after draw-off for 2 minutes	The water temperature should equilibrate to at least 50°C after draw-off for 1 minute	These measurements are applicable to non-mixed outlets only
Monthly	Inlets to sentinel TMVs	Temperatures as above	Temperatures as above	Measurements can be made by means of surface temperature probes
Monthly	Water leaving and returning to calorifier			Also to be monitored continuously by BEMS i.e 60°C flow, 50°C return (minimum)
6-monthly	Incoming cold water at inlet to building – in the winter and in the summer	The water should be below 20°C		Also to be continuously monitored by BEMS
Annually	Representative outlets	The water temperature should equilibrate below 20°C after draw-off for 2 minutes	The water temperature should equilibrate to at least 50°C after draw-off for 1 minute	

Table 1: Recommended Test Frequencies

Note: See [Table 2](#) for definition of terms and explanatory notes

Because of the complexity of hot and cold water systems found in healthcare facilities and the responsibility of maintaining a temperature control regime at all times, this guidance suggests that chemical and other water treatments that have been shown to be capable of controlling and monitoring *Legionella* may also be considered (for example chlorine dioxide). Such measures should only be used in addition to maintaining temperature control of hot and cold water systems.

1. Introduction

Preamble

- 1.1 Scottish Health Technical Memorandum 2027: 'Hot and cold water supply, storage and mains services' (Property and Environment Forum Executive, 2001) and Scottish Health Technical Memorandum 2040: 'The control of Legionella in healthcare premises: a code of practice' (Property and Environment Forum Executive, 1999) have both been revised, and have, at the same time, been combined into this single document: Scottish Health Technical Memorandum 04-01: 'Water safety for healthcare premises'. The guidance has been revised in line with changes to relevant regulations, standards, other guidance and also technical developments. This Version 2.1 reflects experience in use with earlier versions and updates information related to *Pseudomonas Aeruginosa* (PA) in line with the latest Health Protection Scotland 'Guidance for neonatal units (NNUs) (levels 1, 2 & 3), adult and paediatric intensive care units (ICUs) in Scotland to minimise the risk of *Pseudomonas Aeruginosa* infection from water.
- 1.2 Scottish Health Technical Memorandum 04-01 now supersedes Scottish Health Technical Memorandum 2027 and Scottish Health Technical Memorandum 2040 and, in addition, absorbs information from Scottish Hospital Technical Note 6 and Scottish Guidance Note regarding 'safe' hot water and surface temperatures.
- 1.3 This Scottish Health Technical Memorandum gives comprehensive advice and guidance to healthcare management, design engineers, estate managers and operations managers on the legal requirements, design applications, maintenance and operation of hot and cold water supply, storage and distribution systems in all types of healthcare premises. It is equally applicable to both new and existing sites.

In its new form, the document is divided in seven parts. This part (Part B) covers operational management, including the control of *Legionella*. Part A outlines the principles involved in the design, installation and testing of the hot and cold water supply, and storage and distribution systems for healthcare premises. Parts C & D respectively cover a standard TVC testing protocol and Water Disinfection. Part E deals with alternative materials and filtration while Part F deals with chloramination of water supplies. Part G provides advice on the preparation of Written Schemes.

General

- 1.4 Current statutory legislation requires both management and staff to be aware of their individual and collective responsibility for the provision of wholesome, safe hot and cold water supplies, and storage and distribution systems in healthcare premises.

- 1.5 Healthcare premises are dependent upon water to maintain hygiene and a comfortable environment for patients and staff, and for clinical and surgical care.

The development, construction, installation and maintenance of hot and cold water supply systems are vital for public health.

Interruptions in water supply can disrupt healthcare activities. The design of systems must ensure that sufficient reserve water storage is available to minimise the consequence of disruption, while at the same time ensuring an adequate turnover of water to prevent stagnation in storage vessels and distribution systems.

Exclusions

- 1.6 Although many of this Scottish Health Technical Memorandum's recommendations will be applicable, it does not set out to cover water supply for fire-fighting services nor water supply for industrial or other specialist purposes, other than to indicate precautions that should be taken when these are used in association with 'domestic' water services. The point at which a domestic activity becomes an industrial process, for example in food preparation, has not been defined, and the applicability will need to be considered in each case.
- 1.7 This SHTM does not cover wet cooling systems such as cooling towers. Guidance on these systems is given in the Health & Safety Commission's Approved Code of Practice and guidance document L8. Although none remain within NHS Scotland estate there are some within close proximity to healthcare premises where wind-borne aerosols could be drawn in via air intakes or openable windows.
- 1.8 While some guidance on other water-service applications is included, it is not intended to cover them fully. For:
- laundry, see Health Building Note 25: 'Laundry' (now archived);
 - sterile services departments, see SHPN 13: 'Decontamination';
 - hydrotherapy pools, see the Public Health Laboratory Service's 'Hygiene for hydrotherapy pools';
 - spa pools, see Management of spa pools: controlling the risks of infection. Health Protection Agency, 2006;
 - guidance on birthing pools, see Health Building Note 09-02: 'Maternity care facilities'.

Definitions

- 1.9 Definition of terms is as those contained in the Scottish Water Byelaws 2004, BS6100: 1984-2000; BS6700: 2006; and BS EN 806-1-5: 2000-2012 and/or BS8558: 2011.

2. Management responsibility

- 2.1 Management has the overall responsibility for implementation procedures to ensure that safe, reliable hot and cold water supply, storage and distribution systems operate within the organisation. The Approved Code of Practice and guidance entitled 'Legionnaires' disease: The control of *Legionella* bacteria in water systems' (L8) requires that there must be a Written Scheme in place in respect of controlling *Legionella* in water systems.
- 2.2 These procedures should demonstrate that any person on whom the statutory duty falls has fully appreciated the requirement to provide an adequate supply of hot and cold water of suitable quality. Though compliance with this guidance may be delegated to staff, or undertaken by contract, accountability cannot be delegated. The duty holder should appoint a person to take day-to-day responsibility for the control of the hot and cold water services and to be responsible for assessing and controlling any identified risks from *Legionella*.
- 2.3 A risk assessment for the water services will be necessary to identify potential problems in the system, for example excess storage capacity, temperature distribution problems, low water usage, inappropriate materials etc. The risk assessment should be carried out by a competent person. It is recommended that companies / individuals who carry out risk assessments should be members of the *Legionella* Control Association. A standard specification for, and guidance on, water risk assessment can be found in BSRIA's (1999) FMS 4/99: 'Guidance and the standard specification for water services risk assessment'.
- 2.4 Management procedures must ensure that compliance is continuing and not notional. The prime purpose of the assessment is to be able to demonstrate that management has identified all the relevant factors, has instituted corrective or preventive action, and is monitoring the plans being implemented.
- 2.5 This guidance should be applied to all healthcare premises, however small, where there is a duty of care under the Health and Safety at Work etc Act 1974.
- 2.6 Where new healthcare premises are to be built in separate phases, the water storage, supply and distribution service for the whole premises should as far as possible be planned and evaluated at the design stage. This will enable the total water supply requirement to be assessed in the planning stages, and appropriate areas of accommodation to be allocated. In situations where there is a phased hand-over or installations are brought into use in sections, temporarily unused pipework should remain filled with water, dosed, regularly flushed and labelled.
- 2.7 Management should also be aware of the legal duty to notify the water authority when it is proposed to carry out works on cold water distribution systems (See Note on page 18 of Part A of this SHTM).

- 2.8 All regular tests and checks set out in this document should be carried out even if they cause minor disruption to hospital services, and comprehensive records should be maintained.
- 2.9 While the ultimate responsibilities as set out in this SHTM in terms of overall management remain with NHS Boards, when a new or recent hospital has been procured via the Public-Private Partnership (PPP) or Private Finance Initiative (PFI) routes, there are changes in the chain of responsibilities.
- 2.10 More often than not, the operator of the facility will subcontract or enter into partnership with a Facilities Management (FM) Provider who will maintain and operate mechanical and electrical installations. It is not unknown for the FM provider to be the NHS Board's own estates staff. Whichever organisation carries out the functions set out in this SHTM, it will be necessary for the same practice and procedures to be carried out, records maintained and reports prepared to maintain an audit trail. These have to be submitted to the NHS Board for which the Hospital has been established. The NHS Board will in any case retain in-house estates staff and/or technical advisers to monitor these records and reports, having the right to comment where performance standards are not being achieved, inspect installations, and seek to ensure that remedial measures are put in hand and monitored as to their effect.

3. Statutory requirements

General

- 3.1 It is the responsibility of management to ensure that their premises comply with all statutes.

Management (owners or occupiers) of healthcare premises have an overriding general duty of care under the Health and Safety at Work etc Act 1974. Therefore, they should ensure that the water supply, storage and distribution services are installed and operated within the terms of the following legislation.

Health and Safety at Work etc Act 1974

- 3.2 Employers have a general duty under the Health and Safety at Work etc Act 1974 to ensure, so far as is reasonably practicable, the health, safety and welfare of their patients, staff and the public who may be affected by workplace activities.

These duties are legally enforceable, and the Health and Safety Executive has successfully prosecuted employers including NHS organisations under this statute. It falls upon owners and occupiers of premises to ensure that there is a management regime for the proper design, installation and maintenance of plant, equipment and systems. Failure to have a proper system of working and adequate control measures can also be an offence even if an outbreak of, for example, Legionnaires' disease or other such incident has not occurred.

The Management of Health and Safety at Work Regulations 1992 & (Amendment) Regulations 2006

- 3.3 These regulations require every employer to make a suitable and sufficient assessment of all risks to health and safety of employees and the public caused by work activities. In addition to *Legionella* and other bacteria, other risks from a hot and cold water distribution system include deterioration of water quality, scalding at hot water outlets and danger due to pipe bursts at excessive pressures.

Control of Substances Hazardous to Health (COSHH) Regulations 2002 & (Amendment) Regulations 2004

- 3.4 These regulations apply to microorganisms such as *Legionella* and to the chemicals that may be used to control the growth of microorganisms in water supplies. Employers have a duty to assess the risks from exposure to these substances to ensure that they are adequately controlled.

Public Health (Infectious Diseases) Regulations 1988

- 3.5 The Public Health (Notification of Infectious Diseases) Scottish Regulations 1988 require that a properly appointed officer shall inform the Chief Medical Officer for Scotland, as the case may be, of any serious outbreak of any disease that to his/her knowledge has occurred in the district.

Note 1: The Health and Safety Commission's (2000) Approved Code of Practice L8 (see paragraph 2.1) contains further advice and guidance on communication and cooperation with Public Health Doctors and arrangements for supporting them and for them to have access to provider units, including NHS Boards.

Water Supply (Water Quality) (Scotland) Regulations 2001

- 3.6 The Water Supply (Water Quality) (Scotland) Regulations 2001 (and 2010 amendments) apply to water supplied to any hospital which is used for domestic purposes such as drinking, washing or cooking. Two additional sources of advice on drinking water quality are:

- the director of public health;
- the World Health Organisation's (1993) 'Guidelines for drinking water quality'.

The Water Supply (Water Quality) (Scotland) Regulations 2001 also cover private water supplies such as boreholes and wells.

Food Safety Act 1990

- 3.7 The Food Safety Act 1990 covers water used for food preparation or food manufacture and also includes water used for drinking. The Food Safety (Temperature Control) Regulations 1995 and the Food Safety (General Food Hygiene) Regulations 1995 are also relevant.

The Health and Safety Commission's (2000) Approved Code of Practice L8

- 3.8 The Health and Safety Commission's (2000) Approved Code of Practice L8 came into effect on 8 January 2001 and replaced the earlier publication entitled 'The prevention or control of Legionellosis (including Legionnaires' disease) (L8 rev.)' and the technical guidance document HS(G)70 'The control of Legionellosis including Legionnaires' disease'. The onus is on management to demonstrate that procedures in place are as good as, or better than, those required by L8.

The Approved Code of Practice L8 has a special legal status. Health and Safety inspectors seek to secure compliance with the law and may refer to L8 as an illustration of good practice.

Compliance with this guidance document SHTM 04-01: 'Water safety for healthcare premises' will generally satisfy the Approved Code of Practice L8.

- 3.9 The Health Service, with responsibility for the wider aspects of public health and the operation of NHS premises, is expected to be particularly vigilant. The number of outbreaks of Legionnaires' disease is relatively small, but outbreaks are considered to be avoidable. Management must also acknowledge that incidents or outbreaks cause widespread concern, especially if associated with healthcare premises. Investigation of these outbreaks has shown that they are generally related to a breakdown in management systems. Design flaws and defects, however, have also been implicated as the cause of some outbreaks, but by far the greatest contributor to outbreaks of *Legionella* is poor maintenance and control procedures.

Hence, managers need to satisfy themselves by monitoring that effective control procedures are being implemented. It is not sufficient merely to devise procedures.

The Scottish Water Byelaws 2004

- 3.10 The water authority (See Note 1 in Part A of this SHTM) responsible for water supply has a statutory duty to enforce the Regulations for the prevention of waste, undue consumption, misuse and contamination of water supplied in its area.

The Scottish Water, Water Byelaws 2004 are broadly equivalent to the Water Supply (Water Fittings) Regulations which came into effect in England and Wales 1999. These Regulations are set out – along with the Department for Environment, Food and Rural Affairs' (Defra) guidance on the Regulations and the water industry's recommendations for fulfilling these provisions – in the 'Water Regulations Guide' published by the Water Regulations Advisory Scheme ('WRAS'). WRAS provides advice on water fittings regulations on a national basis and administers the scheme, which tests and lists water fittings and materials for compliance with the Regulations. The 'Water Fittings and Materials Directory' contains information on suitable fittings and materials and is updated every six months.

British Standards

- 3.11 BS6700: 2006 has been the British Standard specification for design, installation, testing and maintenance of services supplying water for domestic use within buildings and their curtilage. This has been superseded by BS8558: 2011 which provides complementary guidance to BS EN 806, the final part of which (Part 5) was published in 2012. For a transitional period BS6700 will co-exist with these replacement British Standards.

BS1710: 1984 is the British Standard specification for identification of pipelines and services.

4. The Control of *Legionella*

Source of the bacteria

- 4.1 *Legionella* bacteria are ubiquitous, surviving and multiplying in water. It is widespread in natural fresh water including rivers, lakes, streams and ponds and may also be found in wet soil. Airborne dispersal may occur when water droplets are created. There is a strong likelihood of very low concentrations of the bacteria existing in all open water systems including those of building services.

The risk is related to the number and types of *Legionella* in the water at the point of use.

Ecology

- 4.2 The following conditions have been found to influence the colonisation and growth rate of *Legionella*:

- water temperature between 20°C and 45°C is the range in which *Legionella* will proliferate most rapidly. The optimum laboratory temperature for the growth of the organism is 37°C. *Legionella* are killed within a few minutes at temperatures above 60°C.

Note 2: The death curve is logarithmic with time for a given temperature.

- poor water flow and areas within the water system where water is either stagnant (dead-legs) or is becoming stagnant because water temperature will rise or fall to within the optimum range for growth and the formation of biofilm is encouraged;
- biofilm plays an important role in harbouring and providing favourable conditions in which *Legionella* and other bacteria can grow by providing protection from the effects of heat and biocides, notably chlorine;

Note 3: Biofilm forms when bacteria adhere to surfaces in aqueous environments and begin to secrete a slimy, glue-like substance that can anchor them to many materials such as metals and plastics. A biofilm can be formed by a single bacterial species, but more often biofilms consist of many species of bacteria as well as fungi, algae, protozoa, debris and corrosion products. Essentially, biofilm may form on any wetted surface exposed to bacteria.

Biofilm develops where the temperature is right for growth and where there is a nutrient source. Nutrients can be scale, sediment, corrosion products, or trapped organic and inorganic molecules supplied by the flowing water and lodged in reservoirs created within thermostatic mixing valves.

- *Legionella* has been shown to colonise certain types of water fitting, pipework and material used in the construction of water systems. Water quality can deteriorate in mixing valves, particularly when utilisation is low, because the mixed water can then become stagnant at a temperature favoured by pathogens such as *Legionella*;
- the presence of sediment, sludge, scale and organic material also provides a good nutrient source for *Legionella*. Evidence suggests that the presence of iron oxide (rust) also favours the growth of the organism;
- commonly-encountered organisms in water systems such as algae, amoebae and other bacteria serve as an additional nutrient source for *Legionella* bacteria. Algal slime provides a stable habitat for multiplication and survival. Whilst exposure to direct sunlight may inhibit the growth of *Legionella* bacteria, it does stimulate growth of algae and the formation of slimes. *Legionella* bacteria have also been shown to proliferate rapidly in association with some water-borne amoebae and survive inside amoeba;
- stagnant water encourages colonisation.

Epidemiology

- 4.3 *Legionella pneumophila* serogroup 1 is the commonest cause of Legionnaires' disease. *L. pneumophila* is also responsible for Pontiac fever. Another species, *L. micdadei*, is responsible for a similar illness called Lochgoilhead fever. To date, over 45 species of *Legionella* have been identified. The bacterium can be found naturally in many freshwater sources and can survive a variety of environmental conditions. Virulence may be enhanced when the bacteria have been exposed to temperatures around 37°C which are most favourable to its growth.
- 4.4 The risk of healthcare-associated Legionellosis depends on a number of factors such as:
- the presence of *Legionella* in sufficient numbers;
 - conditions suitable for multiplication of the organisms (for example temperatures between 20°C and 45°C and stagnant water);
 - a source of nutrients (for example sludge, scale, rust, protozoa, algae and other organic matter);
 - a means of creating and disseminating respirable droplets (for example, nearby cooling towers, showers and most other water draw-offs that are capable of creating a spray or causing splashing); and
 - the presence of people who may be exposed to contaminated aerosols, especially those who are vulnerable to *Legionella* infection (for example those with compromised immune or respiratory systems, and transplant patients).

Many, if not all, of these factors are likely to be encountered in healthcare premises.

Control measures

- 4.5 Original guidance on the control of *Legionella* in hot and cold water services relied on a temperature control regime: that is, maintaining cold water below 20°C and hot water above 50°C. Because of the complexity of hot and cold water systems found in hospitals and the difficulty of maintaining a temperature control regime at all times, chemical and other water treatments that have been shown to be capable of controlling *Legionella* may need to be considered to supplement a temperature control regime.
- Residual biocidal techniques such as chlorine dioxide and silver/copper ionisation (evaluated by BSRIA in TN 2/98: 'Chlorine dioxide water treatment – for hot and cold water services'; and TN 6/96: 'Ionisation water treatment for hot and cold water services') are outlined in Section 15 and Appendix 4 of Part A. Due to their residual effect, these techniques can inhibit free-floating and attached bacteria with varying degrees of efficiency. Ozone and ultraviolet (UV) treatment are also mentioned. However, they have a limited effect as UV is non-dispersive, and ozone rapidly degrades and therefore has only a short-term residual effect. Ozone and UV are not effective at removing biofilm from hot and cold water distribution systems. Other techniques, such as the use of silver stabilised hydrogen peroxide, are beginning to be used but care is needed in their application to ensure compliance with legislation and other, related, guidance. **Attention is drawn to Note 23 in Appendix 5 of Part A of this guidance.**
- 4.6 Monitoring to ensure that any of the control measures remain effective is essential. Monitoring and testing is covered in [Sections 9 and 10](#) of this document. Ionisation is pH-sensitive and there have been reports of a reaction between silver and calcium causing staining of sanitaryware. Control of water hardness will be necessary to avoid this, but softening should not be used for drinking water systems. In hot water systems, chlorine is rapidly lost, and maintaining temperature control of the calorifier/water heater and hot water circulating system is of prime importance.
- 4.7 It is essential to review water supply dosing procedures involving chemicals such as silver stabilised hydrogen peroxide, chlorine-based products, etc. and ensure that these cannot impact on patients. Particular attention should be given to sites where sensitive treatment such as haemodialysis (renal dialysis) is performed.
- 4.8 It is also necessary to ensure that procedures are in place to liaise with staff in all areas before chemical dosing of water supply systems is carried out. This should include all locations where haemodialysis takes place, including regular and home haemodialysis units, intensive care units, renal specialist wards and general wards with renal dialysis bays.
- 4.9 A risk assessment should be carried out to identify at-risk areas and sensitive processes which include equipment such as carbon filters and reverse osmosis plant. This risk assessment will identify the method and action to be taken regarding isolation or management of the systems affected.

Route of infection

- 4.10 The principal route of infection is through inhalation of the bacteria into the lungs. The risk rises with increasing numbers of inhaled bacteria. Aspiration of contaminated drinking water into the airways has also been described as a mode of transmission of Legionnaires' disease. For some patients, there is the additional risk of *Legionella* infection from the use of nasogastric tubes.

Aerosol generation

- 4.11 Contaminated water presents a risk when dispersed into the air as an aerosol. This risk increases with reduced droplet size, as smaller droplets remain airborne for longer, and aerosols (5µm diameter or less) penetrate deeply into the lungs (alveoli) and cannot easily be expelled. However, larger droplets can evaporate and still contain the initial number of organisms. Amoebic vacuoles, typically 3µm, may contain many *Legionella* and potentially provide an infectious dose.

In both a cooling tower and an evaporative condenser, water is actively recirculated around these systems, which increases the opportunity for aerosols to be produced. Water services are also capable of generating aerosols from the impaction of water onto hand-wash basins, sinks, baths and showers. In whirlpools, spas and decorative water features, the agitation of the water is achieved by the combination of air jets and pulsating water flow. Splashing water and air bubbles bursting as they break through the water surface create an aerosol immediately above the water surface. The risk of *Legionella* infection increases with the number of infective particles in the aerosol generated, especially if the size of the aerosol is less than 5µm.

Number of infectious bacteria

- 4.12 The number of organisms that cause infection has not been reliably determined and is likely to vary from person to person.

Two factors determine the number of bacteria deeply inhaled:

- the concentration of bacteria in the air:
 - this is determined both by the concentration of bacteria in the water and by the amount of contaminated water dispersed into a given air volume. The concentration of live bacteria in the air falls rapidly with distance from the source. Where an evaporative condenser or a nearby cooling tower and the fresh-air inlet to a building are both at roof level, it may be possible for contamination from the tower to reach the air inlet and hence enter the building;
 - the quantity entering will depend primarily on the separation distance between the source and the fresh-air inlet. Increasing this distance of separation and locating the air inlet upwind (prevailing wind) of the

source help to reduce the likelihood of water droplets containing *Legionella* entering the building;

- the duration of exposure to the contaminated air:
 - exposure in a shower is usually limited to a few minutes, while exposure in a bath, particularly a spa or decorative water feature in a reception or waiting area, or externally, is much longer. Exposure to airborne *Legionella* distributed from a contaminated water-system such as a nearby cooling tower may take place whenever it is operating – this could be most of the day and, if process-related, not confined to summer.
 - the risk increases with the extent of *Legionella* bacteria in the air, the respiratory rate of the individual and the length of time the person is exposed. The chances of *Legionella* infections occurring increase with the number, and susceptibility, of people exposed.

Susceptibility of individuals

4.13 While previously healthy people may develop Legionnaires' disease, there are a number of factors that increase susceptibility:

- increasing age, particularly above 50 years (children are rarely infected);
- sex: males are three times more likely to be infected than females (this may change with altered smoking habits);
- existing respiratory disease that makes the lungs more vulnerable to infection;
- illnesses and conditions such as cancer, diabetes, kidney disease or alcoholism, which weaken the natural defences;
- smoking, particularly heavy cigarette smoking, because of the probability of impaired lung function;
- patients on immunosuppressant drugs that inhibit the body's natural defences against infection.

5. Operational management

General

5.1 Managers should ensure that an operational plan is in place for each site under their control. This document should comprise:

- up-to-date as-fitted drawings, schematic diagrams and descriptions of all the supply, storage and distribution systems within those premises;
- step-by-step instructions to operate, maintain, control and shut down the water supply, storage and distribution systems within those premises;
- a schedule of possible emergency incidents causing loss of the water supply from the water authority (See Note 1 in Part A of this SHTM). Each item in the emergency incident schedule should include guidance on operational procedures to re-establish a stable wholesome water supply.

All premises are required to have a *Legionella* risk assessment and a written scheme for controlling any identified risks in accordance with the Health and Safety Commission's Approved Code of Practice L8. Guidance on the preparation of Written Schemes can be found in Part G of this SHTM.

Competence

5.2 Management should implement a programme of staff training to ensure that those appointed to devise strategies and carry out control measures are appropriately informed, instructed and trained, and should be assessed as to their competency. It is also essential that they have an overall appreciation of the practices affecting water hygiene and safety and that they can interpret the available guidance and perform their tasks in a safe and technically competent manner. The rate of change in building service technology is not great, but knowledge of harmful bacteria continues to grow and management should review the competence of staff on a regular basis, and refresher training should be given; records of training attendance would need to be maintained. Although training is an essential element of ensuring competence, it should be viewed within the context of experience, knowledge and other personal qualities that are needed to work safely. Competence is dependent on specific needs of individual installations and the nature of risks involved.

Safe hot water temperature

5.3 See paragraphs 9.54–9.58 in Part A for guidance on safe water temperatures and delivery devices.

To reduce the risk of scalding, thermostatic mixing devices should be installed for many hot water outlets. A risk assessment will be necessary to establish the need and type of device to be installed.

As with any safety device, routine checks will be essential to ensure continued satisfactory operation. Such devices, however, should not be a substitute for caution, and there are circumstances where nursing staff should always use a thermometer. For example, when performing assisted bathing, it is often necessary to set the delivery temperature to a higher level than that normally considered 'safe' to allow for the cooling effect of large baths that is required.

Before lowering or assisting patients into the bath, the water temperature should be checked with a thermometer to ensure that it has fallen to a 'safe' level. Thermometers should also be used whenever children are being bathed.

Utilisation

- 5.4 One of the critical factors affecting the quality of water within hot and cold water distribution systems is the extent of utilisation. In recent times the provision of alcohol-based hand rubs and additional provision of wash hand basins has resulted in a reduction in water usage per appliance.

Where stagnation occurs or utilisation is low, cold water temperature can increase significantly and approach the range that is conducive to the growth of a variety of water-borne pathogenic microorganisms such as *Legionella*. Where water is mixed, further opportunities arise for deterioration in water quality.

Particular problems occur where a separate thermostatic mixing device is used to provide a safe hot water supply to the inlet port of a second mixing outlet, or where there are separate hot and cold outlets. In this case, the pipe supplying the separate cold tap, or the cold supply to the inlet to the mixing tap, might not be used for periods of time; thus water will become stagnant. Consideration should be given to removal of the separate cold supply and any dead-leg resulting from this. All mixing valves should in any case be easily accessible for routine cleaning and maintenance.

Management needs to ensure that there is good liaison between the estates officers/maintenance providers and clinicians to ensure that the water services are sufficiently used.

- 5.5 Showers are the most critical facilities because of their capacity to generate an aerosol and the potential under-utilisation. Even when patients require assisted bathing, they are likely to use WCs and hand-wash basins, and water usage for these will be maintained. This may be less of a problem in multi-bed wards in which other patients are capable of using showers with or without assistance.
- 5.6 It will be essential to build into the management of the premises a mechanism to ensure that such facilities are routinely operated to draw off water. In healthcare facilities, a higher frequency is recommended, depending on the application, and water draw-off should form part of the daily cleaning process. The procedure for such practice should be fully documented and covered by

written instructions. For control of infection purposes, there has been a growing tendency to specify and install non-touch taps for clinical wash hand basins. It is appreciated that this requires personnel to remain at the tap to create the water draw-off forming part of the daily cleaning process. While occupying time and resources, the benefits of these fittings outweigh any burdens. Consideration should be given to installing taps with automated programmable flushing facilities that can be monitored by an Intelligent Water Management System or hand-held computer.

Note 4: Regular flushing applies to all sporadically used outlets. If used less than once a week, showers should be removed. Safety showers should not be located at the end of lines.

Temporary closure of wards/departments

- 5.7 During temporary closure of wards or departments, a procedure for flushing the hot and cold water service systems should be instituted. This should include opening all taps and showers for a period of three minutes and flushing WC cisterns etc on a twice-weekly cycle. Alternatively, when this is impracticable, the disinfection procedure recommended for new installations may be carried out immediately prior to occupation. This should be applied upstream of the closed area. Taps that include flow regulation may need to be flushed for longer than three minutes. In determining the flushing period, consideration should be given to the water pressure and length of dead-legs and spurs in the connecting pipework.

High risk areas

- 5.8 In specialty departments where patients are particularly susceptible (such as renal wards, transplant units, cancer care areas), it may be preferable to provide separate small-scale systems. Such systems should have independent supply and local heating sources. The use of point of use, hands free water heaters mounted over sinks should be considered.

Additionally, local water treatment may be considered necessary. It is also vital that cold water should be maintained below 20°C.

Note 5: Circulation of cold water and refrigeration should normally only be considered in specialised units where people are at particular risk as a result of immunological deficiency, for example transplant units. For other accommodation, the aim should be to promote turnover of cold water by means of the design of the distribution circuitry. Cooling would, however, only be introduced as a last resort where incoming cold water temperatures dictate.

Cold water services should be sized to provide sufficient flow, and should be insulated and kept away from areas where they are prone to thermal gains. Stagnation should be avoided. Special attention should be given to the maintenance and monitoring of these systems.

Water management policy

- 5.9 It is essential to check regularly systems and all components for signs of leakage; for example, a tap left dripping can waste in excess of 14,000 litres of water each year.

Consumption should be monitored and if it increases for no apparent reason, this may indicate a leak. Wet or soggy patches of ground may identify underground leaks, for example areas of greenery that are more lush than their surroundings.

WC pans and flushing cisterns that use more than 6 litres per flush are prohibited by the Scottish Water Regulations 2004. Further savings can be achieved by the use of dual-flush systems.

Water treatment policy

- 5.10 The water authority (see Note 1 in Part A of this SHTM) is increasingly using chloramines in public water supplies on the grounds that they are more stable and more effective in the control of a variety of water-borne organisms. *The Lancet* has published an article reporting that fewer sporadic cases of community Legionellosis had been reported in areas where the authorities had used chloramine treatment. Chloramines can, however, present problems for dialysis water systems (see Appendix 3 in Part A for further information on the impact of chloraminated water. SHTM 04-01 Part F also refers).

Energy management policy

- 5.11 An energy management policy should be set up to define actions that should be taken to minimise energy consumption. An effective maintenance plan will also contribute to minimising energy consumption. Further guidance is given in Scottish Health Technical Memorandum 07-02: 'EnCO₂de' and the Department of Health's (2004) 'Carbon/energy management in healthcare'.

Maintenance policy

- 5.12 There are legal, operational and economic reasons for introducing a maintenance policy.

There is a legal requirement to protect and preserve the safety of staff, patients and the public. Complying with the law is generally given the highest priority, and is the minimum requirement that must be satisfied. [Section 3](#) lists specific statutes that must be complied with.

Maintenance will be required to achieve optimum economic life and maintain maximum operational efficiency of the plant.

To decide the appropriate level of maintenance (for example scheduled, corrective or condition-based) for the different items of plant, the following questions must be addressed:

- would a breakdown of a particular service during working, or outside normal, hours prove critical?
- how long can a breakdown of particular plant be tolerated?
- what cost can be justified to avoid breakdown of particular plant such as stand-by pumps?

Resolving these issues will set objectives for the maintenance policy. If response to failure is critical for certain items of plant, the maintenance organisation will require a planned strategy of calling out skilled staff to achieve an agreed response time and to minimise the interval between breakdown and the diagnosis and repair of the plant.

Management is ultimately responsible for the provision of a wholesome water supply in the premises under its authority.

- 5.13 The policy for healthcare premises should be based on that of planned preventive maintenance, as any failure in the water services would be seriously detrimental to the provision of healthcare.

Planned preventive maintenance involves a series of inspections at regular intervals and monitoring operating parameters to avoid failure by implementing timely remedial work.

Maintenance responsibility

- 5.14 A manager responsible for maintenance takes responsibility for implementation of the maintenance policy. These responsibilities will include:
- the provision of adequately trained and supervised manpower;
 - clear definitions of the equipment and services to be maintained, together with the procedures to be carried out on them;
 - monitoring of the quality of the work carried out to ensure that it is consistently acceptable;
 - the implementation of financial control procedures.

Contract maintenance

- 5.15 The increasing complexity of building services equipment has resulted in a growing reliance on contractors for the provision of maintenance services. The decision to use either a contractor or in-house staff must be taken in the light of local circumstances.

Contracts between the hospital/healthcare premises and service providers should clearly define the responsibilities of both parties. BSRIA's (1992)

Application Guide AG 4/89.2: 'Maintenance contracts for building engineering services' provide advice on aspects to be considered when obtaining contract maintenance.

Reference should also be made to:

- Part E of this SHTM: Alternative materials and filtration;
- the Heating and Ventilating Contractors' Association's (HVCA) (2004) 'Standard maintenance specification for mechanical services in buildings'.

- 5.16 When selecting subcontractors, particularly in relation to the control of *Legionella*, their competence should be established beforehand (for example companies/individuals who are members of the *Legionella* Control Association).

Maintenance brief

- 5.17 The manager responsible for maintenance requires a brief from the management that sets out in a clear and unambiguous manner the following requirements:

- scope of work;
- budgeting – overall and single item limits;
- level of reliability;
- response time required to correct faults;
- criteria for quality of service;
- reporting procedure;
- accountability and responsibility;
- energy-saving policy;
- health and safety policy;
- environmental and sustainability factors.

The above requirements are necessary regardless of whether the work is carried out by PFI/PPP FM Providers, contractors or in-house staff.

Performance monitoring

- 5.18 This involves the regular inspection of systems and records, which should be in such detail as to enable management to form an opinion regarding compliance with the agreed criteria.

If a contractor is commissioned to carry out maintenance and in-house expertise is not available to monitor their performance, an independent professional adviser should be retained to carry out this function. Using another maintenance contractor in a monitoring role could lead to a conflict of interest.

Performance monitoring should establish that:

- the required level of service is met;
- all the required plant is being maintained;
- system performance is being maintained (where water treatment is provided as part of the control strategy, it will be necessary to test for *Legionella*);
- maintenance is being carried out to the agreed standard;
- correct replacement parts are being used;
- the agreed spares stocks are being held on site;
- records are being correctly maintained;
- the agreed standards, number of staff, and number of visits are being achieved;
- plant is being operated to achieve optimum energy usage;
- health and safety requirements are being complied with;
- only agreed subcontractors are being employed (see [paragraphs 5.16](#) and [6.8](#));
- the client and typical users of the building are satisfied;
- invoices accurately reflect the work carried out, including materials expended;
- breakdowns do not occur too often;
- adequate consideration is being given to the potential environmental impact of contractors' action, for example disposal of lubricants, chemicals, worn parts etc that cannot be recycled.

Emergency action

5.19 Contingency plans should be available in the event of the following:

- a power failure causing failure to maintain temperature in calorifiers or affecting distribution/circulating pumps (such action might require the removal of a calorifier from service for thermal disinfection, to be followed by thermal disinfection of the entire system);
- a mains water failure that could last beyond the period for which storage capacity has been designed (such action might entail advising clinical staff to restrict the amount of bathing/showering that takes place, temporary cessation of laundry and sterile supply activities; in extreme conditions, it may be necessary to resort to 'tankered' water supplies).

Emergency action in an outbreak of healthcare associated Legionellosis is covered in [Appendix 1](#).

Documentation

- 5.20 It is essential to have comprehensive operational manuals for all items of plant that include requirements for servicing, maintenance tasks and frequencies of inspection.

This information should be kept together with all commissioning data.

Documentation should also be drawn up as part of the health and safety file for the building or hospital (see Section 18, Part A).

As-fitted drawings

- 5.21 The availability of accurate as-fitted drawings is essential for the safe operation of hot and cold water service systems. The drawings will be necessary to perform the temperature control checks on the systems and will assist in identifying any potential problems with poor hot water circulation and cold water dead-legs where flow to sporadically used outlets can be low. Such information should identify all key components in the installations, for example water meters, storage tanks (filtration equipment, where fitted), calorifiers, and the location of isolating valves in the systems. Separate schematic drawings should be prepared and displayed in plantrooms such that all plant items, control valves etc can be identified. Record information should be stored electronically wherever possible in addition to hard copies.
- 5.22 In addition to drawings, there should be comprehensive schedules of outlets, lists of sentinel taps (outlets), other outlets to be tested annually and other components in the system.

Record-keeping

- 5.23 Management should ensure that an accurate record of all assets relating to the hot and cold water distribution systems is set up and regularly maintained. They must also ensure that records of all maintenance, inspection and testing activities are kept up-to-date and properly stored. Records should be kept for at least five years.

As a minimum, the following items should be recorded:

- the names and positions of those responsible for performing the various tasks under the written scheme;
- a *Legionella* risk assessment and a written scheme of actions and control measures;
- details of precautionary measures that have been carried out, including sufficient detail to identify that the work was completed correctly and when the work was carried out.

5.24 Planned preventive maintenance will help to ensure that systems perform correctly, and an essential element of this process is the maintenance of accurate records.

Maintenance records are normally required for the following purposes:

- verification of maintenance for local accountability;
- verification of maintenance for statutory obligations;
- as a means of monitoring the maintenance policy and its effectiveness;
- as a means of observing performance trends, initiating corrective action where necessary;
- as an aid to financial planning.

Maintenance records should include the following:

- details of remedial work required and work carried out;
- details of cleaning, disinfection procedures;
- results of chemical and microbiological analysis of water.

When alterations to plant or systems are implemented, the record drawings should be updated to reflect the modifications carried out.

5.25 An asset register for the engineering services would provide a structure for recording, retrieving and analysing information.

The asset register should be designed to provide the following information:

- an inventory of plant;
- a basis for identifying plant details;
- a basis for recording the maintenance requirements;
- a basis for recording and accessing information associated with maintenance;
- a basis for accounting to establish depreciation and the provision needed for plant replacement;
- information for insurance purposes.

5.26 When completing records, it is essential that the individual concerned signs and dates the entries, and that there is an audit trail in place. Pro forma log sheets for temperature checks are included in [Appendix 2](#).

Further information on the monitoring of performance and effectiveness in carrying out maintenance tasks can be found in The Chartered Institution of Building Services Engineers' (CIBSE) (2000) 'Guide to ownership, operation and maintenance of building services'.

Accommodation periodically used

- 5.27 Departments within hospitals closed at weekends, clinics and GP or Dental premises similarly utilised will require their stored water temperatures at all times to be maintained within the same parameters as during normal usage. There is no practical alternative to this if re-pasteurisation with hot water at 70°C is to be avoided every time prior to putting accommodation back into use. Ignoring this requirement involves non-compliance with Workplace Regulations and the issue affects all NHS contractors.

Water Safety Plan and Risk Assessment of Water Distribution Systems

- 5.28 A risk assessment of the water distribution system in a healthcare facility is a legislative requirement. A water safety plan (WSP) approach, incorporating a risk assessment, is outlined in the World Health Organisation (WHO) document Water Safety in Buildings, 2011.

The latest HPS/HFS Guidance on *Pseudomonas aeruginosa* – advice for augmented care units, also recommends that a Water Safety Group (WSG) commissions and develops a WSP which includes a risk assessment. The key steps of a WSP, including a risk assessment, are outlined below.

- 5.29 Key steps of a Water Safety Plan for a Healthcare Facility

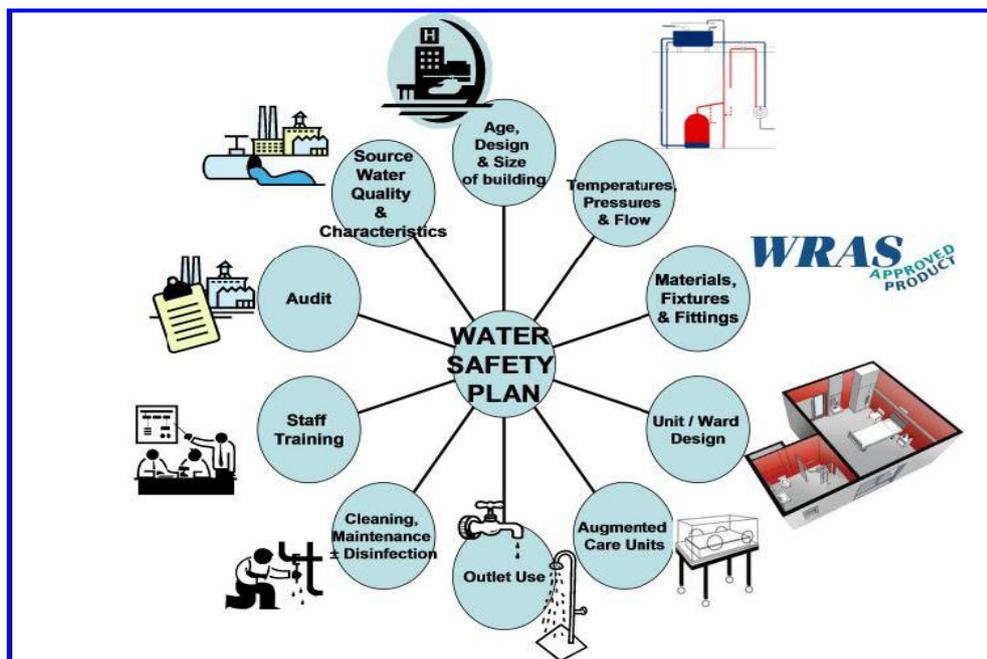
- establish an Environmental Monitoring Committee (or equivalent);
- document and describe the entire water distribution system including schematic diagrams;
- carry out a hazard analysis and risk characterisation, assessing likelihood and impact;
- assess the risks pertaining to all water, water systems, water uses, routes of exposure and patient risk groups;
- assess incoming source water quality and composition;
- identify and evaluate existing control measures;
- identify and implement additional control measures;
- carry out scalding risk assessments;
- enter ongoing risks onto the facility's risk register and manage appropriately;
- monitor and audit control measures;
- ensure maintenance is carried out in line with current recommendations;
- maintain an up-to-date hygiene logbook;
- develop written policies and procedures;
- develop a contingency plan for major disruptions to the incoming water supply;

- establish a communication plan;
- provide staff training and ensure competency;
- carry out the necessary validation, verification, and audit processes;
- a WSP is a dynamic working document. It is important that it is not seen as a one-off exercise. It must be kept up-to-date. Many factors in the day-to-day running of a facility can affect the risk of water system contamination such as:
 - planned/unplanned works or maintenance on the water system;
 - building renovation or refurbishment;
 - closure and re-opening of the facility or parts of it (planned or unplanned);
 - change of use of the building or part of it;
 - disruptions to the water supply to the facility.

5.30 The WSP should be reviewed on an annual basis and when there are alterations, repairs, changes of use, building works, or critical incidents.

Sites where there are mixed uses such as buildings for direct healthcare provision and buildings for administration are often supplied by the same mains water supply. However water systems use within both will be substantially different and can negatively impact in either direction. This must be addressed during the development of a WSP and there must be clear responsibility for the safety of water on the site.

The key factors that influence risk and that should be incorporated in a healthcare facility’s WSP and assessed as part of the risk assessment are illustrated below.



6. Hierarchy and designated staff functions

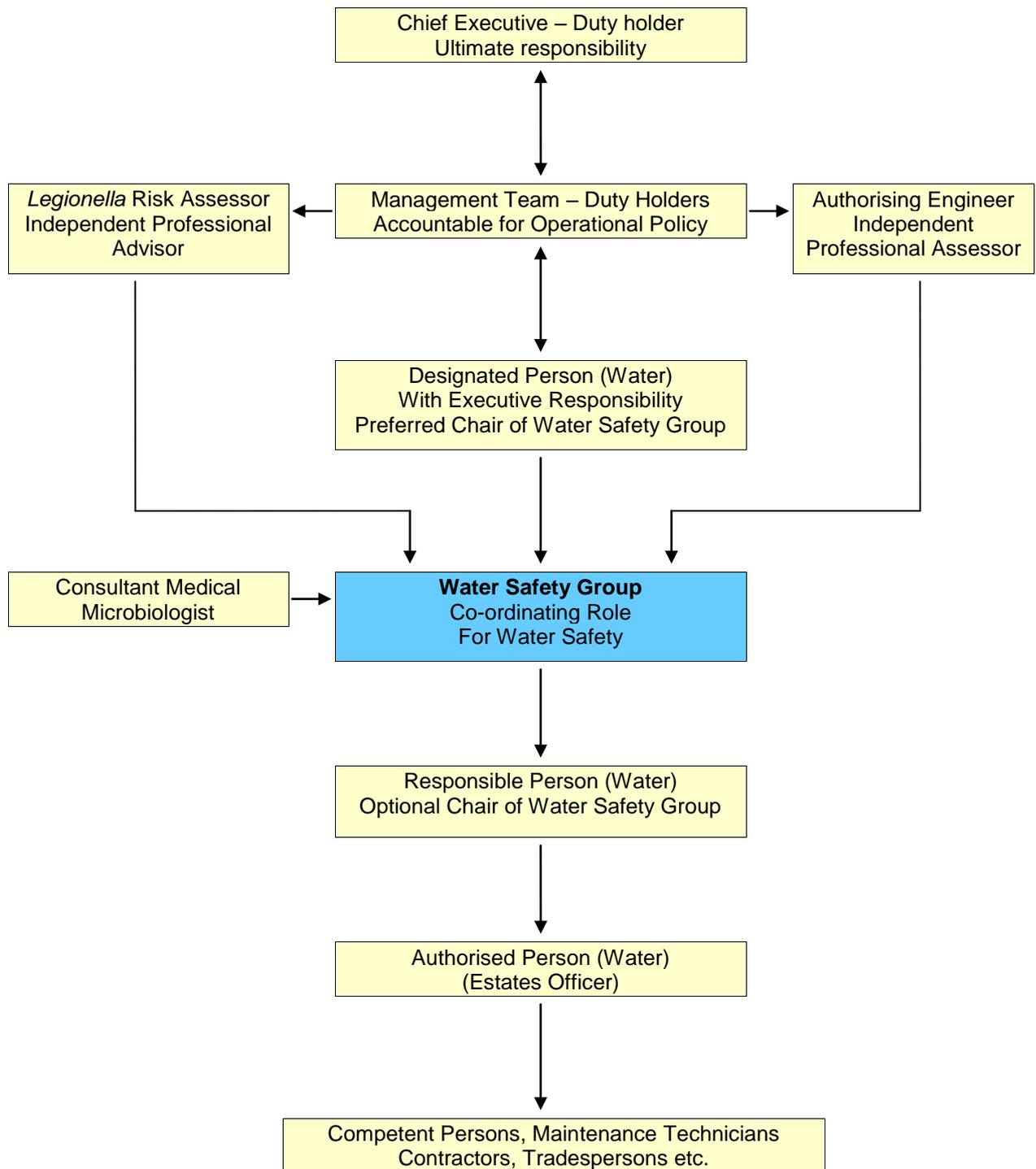
Management

- 6.1 Management is defined as the owner, occupier, employer, general manager, chief executive or other person who is ultimately accountable, and on whom the duty falls, for the safe operation of healthcare premises.
- 6.2 A person intending to fulfil any of the staff functions specified below should be able to prove that they possess sufficient skills, knowledge and experience to be able to perform safely the designated tasks.
- 6.3 Management are required to have evidence of commitment and structure to meet the regulatory requirements and a scheme, setting in writing the detail of the principles and procedures for managing and controlling Legionellosis and Water safety risks. This will involve:
- ensuring the Chief Executive (The Duty Holder) and Management Teams (Duty Holders) are aware of and co-ordinate the policy and are familiar with their devolved responsibilities, duties and relevant procedures;
 - providing adequate facilities, resources and competency training to support, implement and maintain all aspects of the policy;
 - providing management and annual performance reports to Chief Executive, Management Teams, Infection Prevention & Control, Occupational Health & Safety, and Risk Management;
 - reviewing the effectiveness of the policy across NHS Board;
 - providing a Water Safety Group to support, co-ordinate and review operational management and controls in accordance with statutory and mandatory requirements;
 - appointing in writing an independent professional advisor to act as “Authorising Engineer (Water*)” with a brief to provide services in accordance with SHTM and HSE guidance under the policy;
 - appointing in writing an independent professional assessor to act as “*Legionella* Risk Assessor” with a terms of reference to provide services in accordance BS8580, SHTM and HSE guidance under this policy;
 - nominating through the Designated Person (Water) the appropriate (Estates) Manager(s) to act as “Responsible Person (Water)” as defined in appointment letters, to adopt day-to-day responsibility for controlling and managing any identified risk from *Legionella* and *Pseudomonas* bacteria under the policy and lead the Water Safety Group. The Head of Maintenance (or appointed deputy) is the “Responsible Person (Water)” managing day-to-day risks and will be the estates lead in the event of an operational incident. In the event of *Pseudomonas* infection, Estates responsibility is limited and the Responsible Person (Water) will require to draw upon experience and specialist advice from a consultant medical

microbiologist, who shall also be a member of the Water Safety Group, to advise and lead on these issues;

- appointing in writing appropriate deputies and “Authorised Persons (Water)” who have authority, competence, knowledge and control of the water systems and installations identified in specific Written Schemes to ensure that all operational procedures and SHTM 04-01 requirements are carried out in a timely and effective manner to documented timescales. The Scheme will involve “Competent Persons”, “Maintenance Technicians”, “Tradespersons”, “Installers”, “Contractors” and “Contract Supervising Officers” co-ordinated with Duty Holders in accordance with SHTM and HSE guidance under the policy;
- A typical basic structure of hierarchy is shown below but this will vary to accommodate varying NHS Board policies or extent of requirement.

Note 6: *Where the designation “(Water)” is referred to throughout this section this embraces *Legionella* and Water Safety statutory and mandatory issues.



Typical structure of hierarchy

Water Safety Group

- 6.4 Water Safety Groups (WSG) within NHS Boards will be led and chaired, as a minimum, by the Responsible Person (Water) who will ensure that responsibility is taken for microbiological hazards and are identified by appropriate Group

members. They will assess risks, identify and monitor control measures and develop incident protocols. WSG should be a sub-group of and report to the Chair of the hospital Infection Control Committee and ensure a coordinated approach exists between Infection Prevention and Control Teams, clinical staff and Estates & Facilities on all water issues. There should be a clear line of responsibility to the Chief Executive through the Infection Control or other Committee.

The Water Safety Group will be responsible for supporting, co-ordinating and reviewing operational management and controls in accordance with statutory requirements (such as COSHH and HSE ACOP L8) and mandatory requirements (such as SHTM 04-01), for when and where water is supplied, stored, distributed and used safely, by:

- providing leadership for the overall provision of water services management and supervision for maintenance, operational and design procedures;
- facilitating Water Safety Group meetings (at least quarterly) with formal minutes, with stakeholders concerned on a regular basis;
- setting, promoting and maintaining consistent standards and practice;
- providing advice and preparation of safety and risk control notices;
- ensuring that Legionellosis risk assessments are compiled and refreshed every two years (with interim risk re-assessment being conducted as and when appropriate e.g. if there is a significant change to a water distribution system or change of use by the users);
- ensuring that Legionellosis risk assessments are reviewed at Water Safety Group meetings;
- ensuring that drinking water quality standards are maintained;
- ensuring that premises and site performance are reviewed in SCART and in the NHS Board (Datix) Risk Register;
- developing and agreeing risk based programmes of work to reduce risk;
- ensuring that the system to collect information and measure the efficiency, effectiveness and reliability of the management arrangements against set performance standards is regularly reviewed and instigating plans for corrective actions where required;
- ensuring that the policy, operational, maintenance and design procedures and training are regularly reviewed and updated as required to take account of new legislation, guidance, changes to personnel, procedures, protocols etc. and as a result of audit findings;
- promoting new technologies and encouraging innovation;
- the Water Safety Group will report quarterly to the NHS Board's Corporate Health & Safety Committee.

Membership will comprise representatives of Senior Nurses, Estates, Medical Physics, Health & Safety and Domestic Services Managers. An acceptable quorum will be determined by individual NHS Boards as appropriate.

Designated Person

- 6.5 The Designated Person (Water) provides the essential senior management link between the NHS Board and its professional support, which also provides independence of the audit-reporting process. The Designated Person will chair or maintain close liaison with the NHS Board Water Safety Groups to provide an informed position at Board level and by:
- making appointments in writing for ‘the Authorising Engineer (Water)’ and ‘the *Legionella* Risk Assessor’;
 - making appointments in writing for ‘Responsible Person and Deputy Responsible Person (Water)’ and ‘Authorised Persons’ (Water);
 - ensuring through the Water Safety Group that water for hygiene is safe;
 - making appropriate Water Safety Group membership appointments.

Infection control officer

- 6.6 The Infection Control Manager, the Infection Prevention and Control Doctor (also known as the Infection Control Doctor) and the Consultant Microbiologist are nominated by management to advise on infection control policy and to have responsibility for the maintenance of water quality from the point it leaves the tap.

The policy should be acceptable to the Infection Prevention & Control Team and they should agree any amendment to that policy.

Responsible Person

- 6.7 The WSG will be lead and chaired by a Responsible Person (Water) appointed by the Designated Person who will possess sound professional knowledge of *Legionella* and water safety issues and appropriate training. The appointment should be in writing by management to devise and manage the necessary procedures to ensure that the quality of water in healthcare premises is maintained. The Responsible Person (Water) should have sufficient authority to ensure that all operational procedures are carried out in an effective and timely manner and be required to liaise closely with other professionals in various disciplines. In addition, the Responsible Person (Water) should possess a thorough knowledge of the control of *Legionella*. *Pseudomonas* outbreaks would have an over-bearing influence from clinical and cleaning procedures and would primarily come within the responsibility of the Infection Prevention and Control Team who would be represented on the Water Safety Group and from whom the Responsible Person (Water) would draw appropriate expertise via a consultant medical microbiologist.

Note 7: NHS Boards may consider that there are advantages in having the Water Safety Group chaired by Designated Person with executive responsibilities and the ability to exchange information to and from Board level while ensuring that all disciplines (i.e. beyond estates functions) fulfil their particular responsibilities (such as flushing and cleaning procedures)

The role of Responsible Person (Water), as part of the Water Safety Group, as described above involves:

- advising on the potential areas of water-related risks and identifying where systems do not adhere to this guidance;
- liaising with the water authority (See Note 1 in Part A of this SHTM) and environmental health departments and advising on the continuing procedures necessary to ensure acceptable water quality;
- monitoring the implementation and efficacy of those procedures;
- approving and identifying any changes to those procedures;
- ensuring equipment that is to be permanently connected to the water supply is properly installed;
- ensuring adequate operating and maintenance instructions exist and adequate records are kept.

Implementation of an effective maintenance policy must incorporate the preparation of fully detailed operating and maintenance documentation and the introduction of a Written Scheme and logbook system. The Responsible Person (Water) should appoint a deputy to whom delegated responsibilities may be given. The deputy should act for the Responsible Person (Water) as delegated and directed.

The Responsible Person (Water) should also be fully conversant with the design principles and requirements of water systems and should be fully briefed in respect of the cause and effect of water-borne organisms, for example *Legionella pneumophila*. The rôle can extend to the operation and maintenance of associated plant. It is recognised that the Responsible Person (Water) cannot be an expert on all matters and must be supported by specialists in specific subjects such as water treatment and microbiology, but he/she must undertake responsibility for calling upon and coordinating the activities of such specialists. Rôles and responsibilities may vary across NHS Boards depending on operational structures.

The Responsible Person (Water) should be aware that manufacturers, importers, suppliers, installers and service providers have specific responsibilities that are set out in the Health and Safety Executive's Approved Code of Practice L8.

Authorised Person

6.8 The Authorised Person (Water) has the key operational responsibility for the service, qualified and sufficiently experienced and skilled for the purpose. He/she will be nominated by the Authorising Engineer (Water) and be able to demonstrate

- his/her application through familiarisation with the system and attendance at an appropriate professional course;
- a level of experience;
- evidence of knowledge and skills.

The Authorised Person (Water) will be appointed in writing as the single person with sole responsibility for the Written Scheme for an individual water system. No work will be carried out on the water system without the knowledge and written consent of the Authorised Person. An important element of the Authorised Person's role is the maintenance of records, quality of service and maintenance of system safety (integrity) together with responsibility for ensuring that delegated projects comply with the NHS Board's *Legionella* policy and procedures.

The Authorised Person (Water) will also be responsible for establishing and maintaining the roles and validation of Competent Person (Water) who may be employees of the organisation or appointed contractors.

Larger sites may require more than one Authorised Person (Water) for a particular service. Administration duties, such as record keeping, should be assigned to specific Authorised Persons (Water) and recorded in the operational policies.

Competent Person

6.9 The Competent Person (Water) provides skilled installation and/or maintenance of the specialist service. He/she will be appointed, or authorised to work (if a contractor) by the Authorised Person (Water). He/she will demonstrate a sound trade background and specific skill in the specialist service, working under the direction of the Authorised Person (Water) in accordance with operating procedures, policies and standards of the service.

Maintenance technician

6.10 A Maintenance Technician is someone who has sufficient technical knowledge and the experience necessary to carry out maintenance and routine testing of the water, storage and distribution system.

Tradesperson

- 6.11 A Tradesperson is someone who is appointed in writing by the Authorised Person (Water) to carry out, under the control of the Maintenance Technician, work on the water, storage and distribution system.

Installer

- 6.12 An Installer is the person or organisation responsible for the provision of the water, storage and distribution system.

Contractor

- 6.13 A Contractor is the person or organisation designated by management to be responsible for the supply, installation, validation and verification of hot and cold water services, and for the conduct of the installation checks and tests. In relation to the control of *Legionella*, it is essential to ensure that potential contractors have suitable qualifications (for example companies/individuals who are members of the *Legionella* Control Association).

Contract Supervising Officer

- 6.14 The Contract Supervising Officer is the person nominated by the management to witness tests and checks under the terms of contract. He/she should have specialist knowledge, training and experience of hot and cold water supply, storage and mains services.

Authorising Engineer

- 6.15 An Authorising Engineer (Water) acts as an independent professional advisor to the NHS Board, appointed by the organisation with a brief to provide services in accordance with SHTM guidance.

The Authorising Engineer (Water) acts as an assessor, making recommendations on Duty Holders and for the appointment of Designated Persons, Authorised Persons and Competent Persons, monitoring the performance of the service and providing an annual audit to the NHS Board's Designated Person.

Legionella Risk Assessor

- 6.16 The *Legionella* Risk Assessor acts as an independent professional advisor to the NHS Board, appointed by the Board with a brief to provide services in accordance with BS8580. The *Legionella* Risk Assessor shall:

- have demonstrable competence and proven knowledge of *Legionella* bacteria relevant to NHS healthcare water systems;

- be UKAS, or equivalent, accredited;
- be provided with NHS Policies, Procedural documents, any existing *Legionella* Risk Assessments and a current List of NHS Board owned and leased sites;
- provide under an agreed programme, to the General Manager, Facilities and Estates, a *Legionella* Risk Assessment, on an agreed template, for each individual Water System within NHS Board sites in a Microsoft Word (or Excel) format;
- use the formal criteria highlighted in the NHS Board Risk Assessment Policy and NHS Scotland National Risk Matrix to develop and determine specific (using Impact/Consequence and Likelihood definitions within the 5 x 5 Risk Matrix scoring system) *Legionella* Risk Assessments with BS8580 criteria. Highlight assumptions, prove calculations and individual responses to identified risks in each level (Risk Prioritised Action Plan).
- highlight in each Risk Assessment, considerations for:

Contamination	Host susceptibility
Amplification	Operational history
Transmission	New and emerging technologies
Exposure	Drinking water quality

- to an agreed template, provide an Executive Summary Report (including all information sortable in Microsoft Excel spreadsheet format) in prioritised risk level order, applicable to all *Legionella* Risk Assessments being undertaken on NHS Board owned and leased sites, premises/building blocks, plant and water systems. This will include review and re-audit where a Risk Assessment has been carried out prior to this appointment;
- identify operational safety issues;
- identify any Water Systems that cannot be fully assessed and highlight the reasons why not;
- identify any aspects of the Risk Assessment that require further specialist knowledge or equipment (including PPE, access, restrictions, permit to access/work, and the need for a competent escort who is familiar with the system(s)) in order to complete the assessment or avoid put themselves or others at risk during the assessment;
- identify whether a Written Scheme and or Schematic Drawing has to be prepared or redrawn as part of the assessment and its coverage;
- ensure that *Legionella* Risk Assessments will be made available to the Authorising Engineer (Water) and the Water Safety Group.

The above can be summarised as follows:

- provision of a descriptive plan of the extent, condition and design of installations;
- assessment of risk arising from bacterial contamination and scalding;

- preparation of Risk Assessment Score Matrix;
- identification of faults with comments, recommendations and priorities for remediation;
- provision of management systems and Planned Preventive Maintenance task analysis;
- provision of domestic hot & cold water services condition and temperature analysis;
- provision of a schedule of dead-legs and infrequently used facilities;
- provision of survey, inventory and assessment of shower thermostatic mixing valves and outlets;
- provision of a condition report for cold water storage tanks and calorifiers.

7. Description of systems, operational considerations and requirements

Source of supply

- 7.1 See Section 2 in Part A for comprehensive guidance and information on sources of water supply.

If supplies are taken from local boreholes or wells etc, the water should be tested to comply with the requirements of the Water Supply (Water Quality) (Scotland) Regulations 2001 and 2010. The results of all analyses should be kept and recorded.

Water supply hygiene

- 7.2 Normally a supply from a water authority (See Note 1 in Part A of this SHTM) should not require additional disinfection, but all piping, fittings and associated services used for the conveyance of water for domestic purposes must be disinfected before being brought into use. Such piping, fittings and storage cisterns must also be disinfected on completion of works which have entailed 'opening up' the system.

Private supplies taken from boreholes or wells etc will require regular testing, (see paragraph 7.1, above), and will generally require to be disinfected before being used for domestic purposes. Disinfection is effected by chemical or physical agents – the method generally used is chlorination.

- 7.3 Despite disinfection of systems, some outbreaks of disease related to treated water supplies still occur. To reduce the risk of such outbreaks, the design should eliminate:

- direct contact with the internal parts of water pipes and structures by people, animals or birds;
- backflow (back-siphonage) of contaminated water into systems conveying potable water (mains and storage structures).

Measures to protect against back-siphonage are set out in the WRAS 'Water Regulations Guide'. The principle is that the design of piped water systems should be carried out in a manner that minimises the likelihood of contaminated material, or water, gaining access to those parts of any water service conveying potable water. All water from non-potable sources (rain, surface run-off water, private supplies, drainage of foul water etc) must be regarded as a potential source of pathogenic material. (Section 14 in Part A also refers)

Chlorination

- 7.4 Disinfection using chlorine should be carried out in accordance with BS6700: 2006 and its successors BS 8558 and BS EN 806 as described in [paragraph 3.11](#) (see also Section 17 in Part A) and under the direct supervision of a nominated person.

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 (SEPA) which is responsible for land drainage and pollution control. The authority responsible for pollution control should be informed. Dechlorination can be achieved using either sulphite or bisulphite or meta-bisulphite.

Thermal disinfection (of hot water service systems)

- 7.5 This process introduces a serious scalding risk, and it is essential that steps are in place to ensure that access is limited to authorised personnel only until such time that the system has returned to normal operating temperature. It is unlikely to be a practical alternative for a large system.

This process can be performed by raising the temperature of the entire contents of the calorifier, followed by circulating the water throughout the system for at least an hour. The process, however, is impractical for all but small systems. The calorifier temperature must be sufficiently high to ensure that the temperature in all parts of the circulating system, and at the calorifier return, does not fall below 60°C. After this period, each tap or outlet should be run sequentially, with the draw-off at the furthest tap or outlet being for a period of five minutes. Then each tap should be flushed back to source for the same period of time.

In the case of non-recirculating systems that have trace heating, the whole system should similarly be raised to 60°C for at least an hour before draw-off commences. However, trace heating systems are not recommended for other than very small installations or where there are recurrent localised depressed temperatures forming part of circulation systems.

Water treatment

- 7.6 *Legionella*, like other opportunist pathogens including *Aeromonas hydrophila* and *Pseudomonas aeruginosa*, are common in the environment and therefore can seed untreated water systems during construction and subsequent use. Contamination of water systems by microorganisms can also be introduced during refurbishment, repair and alteration, or during routine inspection and sampling.

The need for water treatment and the method of application depend on the purposes for which the water is to be used and the quantity required for each purpose.

In a properly installed and commissioned hot water system, it should be possible to maintain a temperature of at least 55°C at the furthest draw-off point in the circulating system, and 50°C in the circulating system's return connection to the calorifier. In older premises, however, this may not be possible, and in the case of cold water systems it is not always possible or practicable to maintain temperature below 20°C because of utilisation and complexity. It may therefore be necessary to apply additional residual biocidal water treatment that has been shown to destroy and remove biofilm. Information on these techniques can be found in [paragraphs 7.7](#) and [7.13](#).

Where automatic equipment is used for disinfection, it should indicate any change in the amount or concentration of material injected into the water so that immediate action can be taken.

Continuous dosing with appropriate biocides that have proven efficacy should be considered during construction to prevent the accumulation of biofilm. A regular flushing programme for all outlets should also be implemented.

The continuous on-site chlorination of hot and cold water service systems to control the growth of *Legionella* is not generally recommended. Treatment using chlorine dioxide can be used.

In defining their responsibilities, service providers should be asked to advise on test methods and anticipated concentrations of residual chemicals within the system. (See also Sections 3 and 15 in Part A for more guidance on water treatment regimes.)

Chlorine dioxide

- 7.7 Chlorine dioxide is an oxidising biocide that is capable of reacting with a wide range of organic substances. Its effectiveness in the control of organisms in water systems has been demonstrated in a study carried out by BSRIA (see BSRIA's (1998) TN 2/98: 'Chlorine dioxide water treatment – for hot and cold water services').

In the inactivation of microorganisms, the chlorine dioxide molecule acts as a free radical (oxidising biocide) that readily bonds with the amino acids (the basic building blocks of proteins, which form the living cells). This results in their destruction.

Chlorine dioxide as a control measure

- 7.8 The use of chlorine dioxide as a control measure will depend on the design of the systems in use and their operational history. (See also Appendix 4 in Part A.)

There are two aspects to be taken into consideration:

- in the cold water distribution system, chlorine dioxide will be injected into the system upstream of all parts of the distribution, storage and boosting equipment – that is, at the curtilage of the premises;

Note 8: Backflow prevention is required if chlorine dioxide is injected into a pipe connected to the mains supply.

- in the case of hot water distribution systems with calorifiers/water heater operating conventionally (that is, at 60°C), there will be a tendency for chlorine dioxide to be lost by 'gassing off', especially if the retention time in a vented calorifier/water heater is long. In most cases, however, some level of total oxidant should be found in the hot water, although at concentrations far less than the 0.5 mg/litre injected. The calorifier/water heater should act as a barrier to dispersal of any pathogenic material by the hot water system (even if the cold water supply quality is not under control).

Note 9: Chlorine dioxide and its breakdown products chlorite and chlorate can be deleterious to neonates and renal dialysis patients, and should be removed from the water supply to these units. For all practical purposes in water, ppm = mg/litre.

Maintenance of the control regime

7.9 This depends on four separate aspects, as follows:

- ensuring that the dosing equipment is operating satisfactorily;
- ensuring that the limit for total oxidant in the system is not exceeded;
- ensuring that all parts of cold and blended water systems are exposed to chlorine dioxide;
- ensuring that a management system is in place to maintain these procedures, including communication between heads of department, to ensure that problems with the system, or changes in use, are brought to the attention of the responsible staff (see Scottish Health Technical Memorandum 00: 'Policies and principles').

Ensuring that the dosing equipment is operating satisfactorily

7.10 Generally this is the responsibility of the supplier of the dosing equipment, who will seek to achieve the maximum available chlorine dioxide from the generation process. (Systems are not 100% efficient, and the free available chlorine dioxide may be less than the permitted limit of total oxidant of 0.5 mg/litre but should not be significantly less at the point of injection.) When chemical treatment is introduced as part of a programme of remedial action of a colonised system, as the system is brought under control, it should be possible to measure increasing concentrations of available (active) chlorine dioxide. With a newly installed dosing system, this may not be possible for several weeks. If chlorine dioxide cannot be identified, tests for total oxidant should be performed.

It will be the healthcare facility's responsibility to check that the equipment is operating, and this should include routine checking of available 'active' chlorine dioxide.

Tests for total oxidant are most easily accomplished by DPD1 tablets. The oxidising effect of chlorine can be removed by first adding glycine, and the remaining total oxidants (including chlorine dioxide, chlorite and chlorate) can then be measured using the DPD1 tablets, following suppliers' instructions.

Note 10: DPD is an abbreviation for diethyl-p-phenylene diamine. DPD1 tablets are used for detecting oxidants in water.

Ensuring that the limit for total oxidant in the system is not exceeded

- 7.11 Feedback control to maintain chlorine dioxide levels at the most distant draw-off positions cannot be used since this would result in the limit of 0.5 mg/litre being exceeded at draw-offs close to the point of injection.

The available chlorine dioxide and total oxidant, therefore, will be the result of the disinfection process, general state of the system and water usage levels. Performance of the dosing equipment is the responsibility of the supplier/service provider. (Water quality overall is ultimately the responsibility of the owners of the system.)

A representative number of outlets should be tested for total oxidant to ensure that the limits are not being exceeded. These should include proximal outlets and some distal outlets. (It should not normally be necessary to check the hot water service whose primary supply is potable.)

Ensuring that all parts of cold and blended water systems are exposed to chlorine dioxide

- 7.12 In addition to the above, it will be necessary to monitor the following:
- the quantity of chemicals in the reservoir;
 - the rate of addition of chlorine dioxide to the water supply;
 - on a monthly basis, the concentration of chlorine dioxide should be measured at the sentinel taps and should be at least 0.1 mg/litre;
 - on an annual basis, the chlorine dioxide should be measured at a representative number of outlets and should be at least 0.1 mg/litre.

Silver/copper ionisation

- 7.13 Ionisation systems release copper and silver ions into the water stream by means of electrolytic action (see also Appendix 5 in Part A). Ionisation as a water treatment method is covered in BSRIA's (1994) Technical Note TN 6/96: 'ionisation water treatment for hot and cold water services' following a study in which it was shown that copper and silver ion concentrations maintained at 400 micron/litre and 40 micron/litre respectively can be effective against planktonic *Legionella* in hot water systems. In soft waters, a silver level as low as 20 micron/litre can be effective. **Attention is drawn to Note 23 in Appendix 5 of Part A of this guidance.**

Maintenance of the control regime

- 7.14 Stable and consistent emission of ions is essential. Manual setting is not recommended, since changes in water quality (conductivity) wear the electrodes, and the insulation of scale formation will affect the level of dosing.

As ions are released in direct proportion to the current flowing between the electrodes, irrespective of voltage, control systems having a constant current arrangement that automatically increase (or decrease) voltage are likely to be the most satisfactory.

It is also possible to control the dosing equipment by metering the incoming flow to the system or its individual sections.

Note 11: Continuous dosing of drinking water with silver ions is inadvisable (see the Drinking Water Inspectorate's recommendations at <http://www.dwqr.org.uk>).

- 7.15 For testing on site, two separate tests are required for each of the elements:
- silver is usually measured by means of a dip slide typically of sensitivity 5 micron/litre to 1 mg/litre. Prior to measurement, chlorine is neutralised by means of aminoacetic acid and the wetted dip slides are compared with a colour chart;
 - copper is tested by means of a titration test whereby reagents are added to water that is then similarly compared with a colour chart. The concentration sensitivity is typically between 0.05 and 1.0 mg/litre.

The tests are not as accurate as atomic absorption. It is generally advised that, on initial introduction of ionisation, test kits are employed for the first few weeks, and when levels are thought to be under control, confirmation is obtained by atomic absorption. After this, test kits can then be used routinely.

Monitoring silver/copper ions

- 7.16 In addition to the above, the following should be monitored:
- on a weekly basis, the rate of release of copper and silver ions into the water supply;
 - on a monthly basis, the silver ion concentration at sentinel outlets should be measured – this should be at least 20 micron/litre;
 - on an annual basis, the concentration of silver ions should be measured at representative outlets – this should be at least 20 micron/litre;
 - on a weekly basis, the condition and cleanliness of the electrodes;
 - on a weekly basis, the pH of the water supply – any significant change should be drawn to the attention of the supplier of the equipment.

Purging the systems

- 7.17 Where chemical treatment is introduced, it is essential to ensure that all parts of the system are purged so that adequate concentrations are achieved.

As temperature monitoring is performed on sentinel and representative outlets on a rolling basis only, additional draw-off will be required at all points on a regular basis.

Ozone and ultraviolet treatment

- 7.18 Whereas the previous treatments are intended to be dispersive (that is, they result in a residual agent within the system), ozone and ultraviolet are intended to be effective close to the point of application. They are not, therefore, necessarily effective in hot and cold water service systems (see Section 15, Part A).

Metal contamination

- 7.19 See Section 6 in Part A.

Filtration

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

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. Further information relating to on-site filtration is contained in Part E of this SHTM: Alternative materials and filtration. Section 5 in Part A also refers.

Water softening

- 7.21 Base-exchange softening removes permanent and temporary hardness from water. The technique uses an ion exchange process in which the calcium and magnesium ions in solution are removed and replaced by an equivalent number of sodium ions.

Daily or frequent backwashing and periodic cleaning and disinfection (six-monthly) must be undertaken in accordance with the manufacturer's/ supplier's instructions. Other proprietary cleaning agents are not recommended,

particularly if the softened supply water serves apparatus such as dialysis machines.

Other water softening methods include physical water conditioning and magnetic water conditioning. The operation and maintenance of these systems should be in accordance with manufacturers' instructions. The efficacy of these water-conditioning measures needs to be considered.

Further information on water softening can be found in BSRIA's Applications Guide AG 2/93: 'Water treatment for building services systems'. See also Table 1 in Section 4 in Part A, which classifies the levels of water hardness.

Metering

7.22 Where water meters are installed in below-ground meter chambers, the chambers should be kept clean of debris and water; this will enable quick and accurate reading of the meters.

Meters should be periodically checked to ensure that they are operating and providing accurate readings.

Meters, other than the water authority's (See Note 1 in Part A of this SHTM) meter, should be removed at such intervals as recommended by the manufacturers for cleaning and renewal of worn parts and should be tested for accuracy prior to replacement.

Meters should be read on a regular basis (monthly) and consumption monitored. A bar graph will highlight unusually large consumption, which can then be investigated.

Consumption should be checked against the utility bill and any discrepancies investigated.

Water storage

7.23 For general information on water storage, see paragraphs 7.1–7.2 in Part A.

The Water Supply (Water Fittings) Regulations 1999 and relevant parts of BS6700:2006, BS EN 806 and BS8558: 2011 specify minimum standards for cold water storage cisterns to ensure that the stored water is retained at a potable standard suitable for domestic use. It is necessary to minimise stagnation and stratification of the stored water. A nominal 12 hours' total on-site storage capacity is recommended. The quantity of the water stored should be carefully assessed in relation to the daily requirement so that a reasonable rate of turnover is achieved. The storage capacity should be reduced where it is known or established that it is excessive and where it is practicable to do so.

All cold water storage cisterns and cold feed cisterns must be examined at least annually, paying particular attention to the presence of foreign objects, biological material and excessive corrosion. On completion of the examinations,

the cisterns should be cleaned, if required, and any remedial work carried out. Before the cisterns and system are put back into use, they should be disinfected in accordance with the procedure detailed in Section 17 of Part A.

Any chemicals used in the cleaning or maintenance of cisterns must be listed in the 'Water Fittings and Materials Directory'.

Cistern insulation should be checked to ensure that it is adequately positioned and in good condition.

Float-operated valves should be checked to ensure that they are securely fixed and set to achieve a correct water level in accordance with the Water Supply (Water Fittings) Regulations 1999.

Overflow/warning pipes should be checked to ensure that they do not rise in level and they are clear and correctly routed to give an obvious visual alarm of an overflow condition. A weatherproof label fixed adjacent to the warning pipe, identifying the tank and its location together with the person/ department to be contacted in the event of a discharge, would contribute to a quick and accurate defect report which could then be acted upon, so minimising water wastage.

A schematic drawing, illustrating piping and valve arrangements for break-tank operation during normal running and maintenance periods, is shown in Figure 2 of Part A.

Pressurisation/supply pumps

- 7.24 Where two or more pumps are installed for pressurising systems, automatic control should be provided to operate the pumps cyclically and sequentially to minimise any danger of stagnation.

The maintenance carried out on this type of equipment should be in accordance with the manufacturer's recommendations. Secondary recirculation pumps should be manually inspected at least monthly to ensure that they are operating effectively.

Cold water distribution system

- 7.25 The design and installation of the cold water distribution system should comply with The Scottish Water Byelaws 2004 and relevant parts of BS6700:2006, BS EN 806 and BS8558. (See Section 8 of Part A for further information.)

The control of water temperature in the cold water service will essentially rely on good insulation and water turnover. Cold water services should be sized to provide sufficient flow and should be insulated and kept away from areas where they are prone to thermal gains. Stagnation must be avoided. Special attention should be given to the maintenance and monitoring of these systems.

Note 12: Automatic flushing of urinals should also be used to assist in water turnover.

Schematic drawings of the system with numbered and labelled valves will reduce confusion and save time in trying to identify appropriate isolating valves and other system components.

7.26 Checks and actions should be carried out to show that:

- system components show no sign of leakage or corrosion;
- system insulation is in good condition;
- system filters have been changed and/or cleaned in accordance with manufacturer's recommendations.
- strainers have been regularly checked and cleaned;
- all isolating valves have periodically been worked through their full range of travel;
- every water outlet complies with the backflow protection requirements of the Scottish Water Byelaws 2004.

Drinking water

7.27 Current guidance does not draw a distinction between drinking and general cold water services; both are considered to be 'domestic'.

The installation of separate drinking water supplies used to be standard policy. However, in many cases where such systems have been installed, the quality of drinking water (particularly at sporadically used draw-offs, for example washrooms) has generally been inferior to that of the general cold water supply.

If separate drinking water supplies are provided, reference should be made to paragraphs 8.13 and 8.14 in Part A.

Hot water storage and distribution

7.28 Hot water services should be designed and installed in accordance with the Scottish Water Byelaws 2004 and relevant parts of BS6700:12006, BS EN 806 and BS8558: 2011. The hot water system may be of either the vented or the unvented type. (See Section 9 of Part A for further information.)

7.29 To control possible colonisation by *Legionella*, it is essential to maintain the temperature within the hot water circulating system. To some extent, if properly maintained, the calorifier/water heater will provide a form of barrier to *Legionella* and other water-borne organisms. The minimum flow temperature of water leaving the calorifier/water heater should be 60°C at all times, and 55°C at the supply to the furthestmost draw-off point in the circulating system.

Note 13: A minimum of 55°C may be required for the operation of suitable mixing devices to provide 'safe' hot water at the upper limit of the recommended range. In large, non-recirculating systems, the minimum of 55°C should be maintained by electric trace heating. Such systems are, however, not recommended.

The minimum water temperature at the connection of the return to the calorifier/water heater should be 50°C. To achieve the required circulating temperatures, it will be necessary to maintain the balance of flows to individual pipe branches and draw-off points.

7.30 Calorifiers should be subjected to regular procedures that include the following:

- cleaning and maintenance;
- quarterly draining to minimise the accumulation of sludge. This may be extended to annual draining if, during inspection, it is found that there is little accumulation of debris;
- whenever dismantled, for statutory inspection, or every year in the case of indirect calorifiers, calorifiers should be thoroughly cleaned to remove sludge, loose debris and scale;
- whenever a calorifier is taken out of service, 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 an hour;
- a calorifier shunt pump will 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 sediment debris. Calorifiers that 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 valve should be left open while the calorifier is out of use;
- users are reminded that if a calorifier is colonised by *Legionella* and is then drained and opened for maintenance purposes, there can be a risk of infection to maintenance personnel and personal protective equipment will be necessary;
- where it is known, or established, that gross over-capacity exists in a calorifier, and where it is practicable to do so, it should be removed;
- approximate calorifier emptying times are shown in Table 3 (Part A).

7.31 Hot water circulating pumps should be of adequate performance to ensure a minimum available temperature at draw-off points of 55°C and an absolute minimum of 50°C at the return connection to the calorifier.

Note 14: Ball-type valves should be specified to avoid clogging. The drain from the gully should be of sufficient size to take the flow from the calorifier drain.

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

Instantaneous water heaters for single or multi-point outlets

7.32 These devices usually serve one draw-off only and are either electrically or gas-heated. The general principles and limitations of instantaneous water heaters are given in BS6700: 2006 and its successors BS EN 806 and BS 8558. In essence:

- the flow rate is limited and is dependent upon the heater's hot water power rating;
- where restricted rates of delivery are acceptable, the heater can deliver continuous hot water without requiring time to reheat;
- they are susceptible to scale formation in hard water areas, where they will require frequent maintenance;
- this form of hot water heating should be generally considered for smaller premises or where it is not economically viable to run hot water distribution to a remote outlet.

7.33 Where electrical trace heating is used, it should be checked routinely (at least monthly) to ensure that it maintains the water temperature above 55°C. Care should be taken to ensure there are no cool spots. Consideration should be given to monitoring the temperatures by means of a Building & Energy Management System (BEMS) (sensors should be located at the most distal points).

Safe hot water delivery devices

7.34 Thermostatic mixing valves for baths, showers and taps should comply with the standards of the Model Engineering Specification D08 – 'Thermostatic mixing valves (healthcare premises)'.

The types of mixing device are specified in Table 4 of Part A.

It is essential to check the temperature settings and operation of all water mixing devices regularly (six monthly, provided that there is no 'drift' in excess of 1°C). The method of testing should be in accordance with Model Engineering Specification D08. Other maintenance should be strictly in accordance with the manufacturer's instructions. The local water quality will influence the maintenance frequency for any installation. A relatively small piece of debris may restrict the operation of the temperature control and fail-safe mechanisms.

The recommendations regarding safe water temperature apply to all ward accommodation, residents' rooms and those areas to which patients, residents and visitors have free access (including public areas). Until the recommended precautions are put into effect, staff should be made aware of the potential danger and take the necessary steps to protect patients, residents and visitors. Areas that do not meet these recommendations should be identified, and plans

to comply as soon as reasonably practicable should be devised. These recommendations apply equally to staff accommodation.

Materials of construction

- 7.35 Systems should comply with the requirements of the Water Supply (Water Fittings) Regulations 1999. Materials used in contact with water that is for drinking etc should comply with BS6920-1: 2000 and be listed in the latest edition of the 'Water Fittings and Materials Directory' published by WRAS.

Temperature control regime

- 7.36 Temperature control regime is the preferred strategy to maintain systems free from *Legionella* and other waterborne organisms. This will require monitoring on a regular basis. The test frequencies are listed in Table 1. (See also BSRIA's Application Guide AG 4/94: 'Guide to Legionellosis – temperature measurements for hot and cold water services'.)

Whereas many of the checks will, of necessity, require the use of separate thermometric equipment, some of the temperature checks can be carried out by continuous monitoring by a BEMS. Where a BEMS is used, it will be essential to ensure that regular calibration and physical tests are performed in accordance with the manufacturer's instructions.

More extensive use of BEMS should be considered: hot water service flow and return temperatures should be monitored at the entry to individual wards, and cold water service(s) at the most distal point(s). In other departments where bathing/ showering is less likely, monitoring should be provided on branches serving up to 50 outlets. The BEMS could also be used to monitor the temperature in non-recirculating systems that have trace heating. The alarm level should be 50°C.

Showers

- 7.37 Hyper-chlorination of showerheads and angle valve strainers has only a short-lived effect on *Legionella*. Manual cleaning to remove scale and other deposits should be carried out at least quarterly, and more frequently if required. Automatic drain valves are ineffective in maintaining a reduction in the number of *Legionella* in shower water, and *they should not be installed* (see the Health and Safety Commission's Approved Code of Practice L8). Regular flushing of showers reduces *Legionella*, but *Legionella* can significantly increase in number if regular flushing should cease. The most effective management of showers will be achieved by the removal of unnecessary ones and the regular use of others. Where showers are removed, it is important to cut back all the associated pipework and remove the redundant tee-piece on the circulating main to avoid creating dead-legs. (Paragraph 7.49 in Part A also refers)
- 7.38 Where it is difficult to carry out flushing to the recommended frequency, stagnant and potentially contaminated water from within the shower and associated dead-leg should be purged to drain immediately before the

appliance is used. This procedure must be carried out with minimum production of aerosols. It is important to note the distinction between self-purging and self-draining showers. Self-purging showers can be an effective *Legionella* control procedure, while self-draining showers can support the proliferation of *Legionella*.

- 7.39 Where showers are confirmed as being used less than once per week, they should be removed.

Point-of-use filtration

- 7.40 Point-of-use filters must be changed in accordance with the manufacturers' recommendations, typically at least once a month. When changing filters, it is recommended that sampling of water quality takes place at outlets identified as sentinel points, before refitting a replacement filter. Except where taking samples as above, once point-of-use filtration has been introduced, taps or showers must not be used without a filter in place.

Where point-of-use filters are no longer required, the outlet and associated pipework must be disinfected to remove any accumulated biofilm before the system is returned to service (see also paragraph 5.16 in Part A). Manufacturer's instructions should be followed at all times.

Summary checklist

- 7.41 A summary checklist for hot and cold water services showing recommended frequency of activity is given in [Table 4](#).

Frequency	Check	Cold water	Hot water	Notes
Monthly	*Sentinel outlets	The water temperature should equilibrate below 20°C after draw-off for 2 minutes ¹	The water temperature should equilibrate to at least 50°C after draw-off for 1 minute ²	These measurements are applicable to non-mixed outlets only
Monthly	Inlets to sentinel TMVs	Temperatures as above	Temperatures as above	Measurements can be made by means of surface temperature probes
Monthly	Water leaving and returning to calorifier			Also to be monitored continuously by BEMS i.e. 60°C flow and 50°C return minimum
6-monthly	Incoming cold water at inlet to building – in the winter and in the summer	The water should be below 20°C		Also to be continuously monitored by BEMS
Annually	**Representative outlets	The water temperature should equilibrate below 20°C after draw-off for 2 minutes ¹	The water temperature should equilibrate to at least 50°C after draw-off for 1 minute ²	

Table 2: Tests for temperature performance

*Sentinel outlets are normally those that – on a hot water service – are the first and last outlets on a recirculating system. On cold water systems (or non-recirculating hot water systems), they are the closest and furthestmost from the storage tank (or water heater). The choice of sentinel taps should also include other outlets that are considered to represent a particular risk, for example those installed in accommodation in which particularly susceptible patients are treated, or others identified in the risk assessment and temperature mapping exercise as having the least satisfactory temperature performance.

**Representative outlets include conventional and mixed-temperature taps; 20% of the total number installed throughout the premises would be tested annually on a rotational basis: that is, all taps checked every five years.

Notes associated with Table 2:

1. The Health and Safety Executive's Approved Code of Practice L8 permits a period of two minutes to achieve an equilibrium temperature below 20°C. Achieving this minimum requirement would be indicative of an exceptionally underutilised water system. (At a typical flow to a hand-wash basin of 4.5 litres/m, 2 minutes to achieve temperature would indicate a 50 m dead-leg of 15mm pipe.)
2. The Health and Safety Executive's Approved Code of Practice L8 permits a period of 1 minute to achieve an equilibrium temperature of 50°C. A minimum of 55°C may be required for the operation of suitable mixing devices required to provide 'safe' hot water at the upper limit of the recommended range. Hot water at 55°C is required in many cases for reasons of food hygiene or decontamination requirements, for example in kitchens and sluice rooms etc. In a properly balanced hot water circulating system, with the circulation taken close to the draw-off point, achieving temperature should be virtually instantaneous. (At a typical flow to a hand-wash basin of 4.5 litres/m, 1 minute to achieve temperature would indicate a 25m dead-leg of 15mm pipe.)

Procedure to be adopted for Cold Water Tanks following identification of water temperatures in excess of 20°C

- 7.42 Drinking water, to a relevant water quality under Regulations, is provided to NHS Boards by Business Stream, a Licensed Provider (LP), who work with Scottish Water to make sure that the water supply is connected properly, and the water is clean and ready to use.
- 7.43 These obligations cover the supply network up to the boundary point (normally the meter point), thereafter obligations rest with NHS Boards. Currently there is no legal maximum water supply temperature from the Licensed Provider. In practice the water supply temperature to boundary point will be subject to seasonal variation. In winter this would normally be expected to be in the 5 – 10 °C range and in summer up to 20°C. Estates managers require to take cognisance of HSE ACOP L8 and seasonal variations in risk assessments, covered by a Written Scheme for each water system with schematic drawings and a risk management system.
- 7.44 The following staged risk assessment escalation procedure should be employed where the water temperature in Cold Water Storage Tanks is greater than 20°C. (i.e. the water storage tanks for Domestic Cold Water Systems and for Domestic Hot Water Systems).

Stage 1 - Verification

- where tepid cold water occurrence (i.e. more than 20 °C) is reported from any numbers of cold water outlets, from maintenance procedures, from BEMS monitoring, or from the manual monitoring of storage tanks, the person identifying, or making a report must notify the relevant Authorised

Person (Water) as soon as the problem is identified and confirm this in writing within 24 hours;

- The Authorised Person (Water) should liaise with the person identifying the problem and verify the problem by independently re-checking by means of taking the water temperature of the appropriate cold water storage tank, the temperature of the incoming mains cold water at the site boundary point (and building entry point if there are multiple buildings served by the mains cold water system) and the outflow distribution temperature;
- if the cold water storage temperature is confirmed greater than 20°C, then the Authorised Person (Water) should record this in writing as well as conducting continuous monitoring of the incoming cold water mains, the cold water storage and the outflow temperatures to establish the temperature profiles and in more detail over at least a one week period to determine the level of risk;
- The Authorised Person (Water) should also review the Water Safety Log Book and take into account the recent water system history specifically to include:
 - the primary water treatment levels (for mains cold water supplied with Chlorine or Chloramination treatment);
 - any water sampling carried out following SHTM 04-01;
 - system monitoring data including temperature monitoring and water quality chlorine or chloramination checks;
 - recent maintenance history; recent alterations, changes or additions to the water system;
 - any other changes made by Duty Holders or users of the water system.
 - On reviewing continuous monitoring temperature profiles action as Stage 2 or Stage 3 or Stage 4 as appropriate should be undertaken. The Authorised Person (Water) will ensure that the Responsible Person (Water) is notified immediately in writing at each stage and also recorded in the Water Safety Log Book.

Stage 2 - Initial Action – high incoming mains cold water temperature

- where the incoming mains cold water is 18°C or greater for more than a 48 hour period the Responsible Person (Water) should contact Business Stream (the Licensed Provider) who will work with Scottish Water to establish the reasons and determine a resolution. Continuous monitoring should continue and recorded in the risk assessment.

Stage 3 - water temperatures fluctuating above and below 20°C (but no greater than 25°C)

- where water temperatures are fluctuating above and below 20°C in a regular cyclical manner over 72 hour periods in response to regular user water demand (but no greater than 25°C) and are more than 2°C higher than the incoming cold water mains supply temperature at the building entry point, then continuous monitoring should be continued by the Authorised Person

(Water). The reason(s) for failure(s) should be identified and rectified as soon as possible. This should be recorded by updated risk assessment (specifically in relation to the patient risk rating – where there may be increased risk and appropriate actions may be required to mitigate exposure).

- considerations for failures include:
 - accuracy of temperature sensors (requiring recalibration);
 - temperature sensors being located in water (requiring reposition where tank storage levels been reduced and sensor no longer sensing stored water);
 - inappropriate standby tank configuration;
 - temperature sensor in standby system;
 - temperature sensor measuring stagnation (requires reposition);
 - inappropriate siting (not in a cool location);
 - heat gain to the tank and pipework (due to lack of appropriate insulation or located close to heat gain from other heat sources);
 - storage capacity not minimised to match daily use;
 - ingress of hot water through cross connection or mixing valve failure (i.e. from DHW system or Steam systems);

Stage 4 - water temperatures fluctuating above and below 25°C (and rarely below 20°C)

- in this situation continuous monitoring should be continued by the Authorised Person (Water), the reason(s) for failure(s) (as Stage 3) identified and rectified on an urgent basis. This should be recorded by updated risk assessment (specifically in relation to the patient risk rating – where there will be an increased risk and appropriate actions will be required to mitigate exposure);
- in this situation a permanent solution, such as ventilation for the plant room, or changing the water storage arrangements, or forming a circulating distribution system (with or without chilling depending on the circumstances) would require to be implemented;
- The Authorised Person (Water) should, unless instructed in writing to the contrary by Responsible Person (Water) implement the following:
 - arrange to drain the tank contents and clean if necessary;
 - inform the users of the failed system that they must not draw off any cold water (and hot water if a single domestic hot water header) from the affected system until further notice;
 - chlorine (or other suitable) disinfection of the tank and distribution system shall be carried out;
 - thereafter the tank shall be brought back into service;
 - finally the users shall be informed that the system is back in operation.

- 7.45 The Authorised Person (Water) shall complete an Incident Report Record Form. An entry should also be made in the Water Safety Log Book and the Responsible Person (Water) should be notified in writing as soon as possible.
- 7.46 Water systems should be cleaned and disinfected under the circumstances in the following Table 3:-

System/Service	Circumstance Requiring Cleaning and Disinfection	Frequency
Domestic Cold Water and Domestic Hot Water Tanks	New installations. Re-commissioning empty/unused tanks. Tank temperature exceeds 25°C. (Check with Risk Assessment). Tank contains moderate sediment, i.e. a complete covering of the tank base. Evidence of tank corrosion (check with Risk Assessment). Any contamination of tank (by organic, by vermin or vermin faeces or similar). Gross organic contamination e.g. large number of dead insects, feathers, animal or bird bodies etc. Regular programme for high-risk healthcare category, with disinfection* where identified in the local Written Scheme (check with Risk Assessment). Regular programme for medium risk healthcare category, with disinfection* where identified in the local Written Scheme (check with Risk Assessment). Regular programme for non-healthcare premises, with disinfection* where identified in the local Written Scheme (check with Risk Assessment).	As required As required As required As required As required As required Annually 2 Yearly 5 Yearly
Domestic Cold Water Distribution System	New installations and modifications or additions. Temperature exceeds 25°C. (Check with Risk Assessment). Any contamination of tank (by organic, by vermin or vermin faeces or similar). Gross organic contamination e.g. large number of dead insects, feathers, animal or bird bodies etc.	As required As required As required As required
Domestic Hot Water Calorifier, Storage/Buffer Vessels	New installations and modifications or additions. Temperature has fallen below 45°C. Re-commissioning of empty/unused plant. Any contamination of header tank (by organic, by vermin or vermin faeces or similar). Regular programme.	As required As required As required As required Annually
Domestic Hot Water Distribution System	New installations and modifications or additions. Temperature has fallen below 45°C. . Any contamination of header tank (by organic, by vermin or vermin faeces or similar).	As required As required As required
Air Handling Units	Any contamination (by organic, by vermin or vermin faeces or similar). Gross organic contamination e.g. large number of dead insects, feathers, animal or bird bodies etc. Chiller battery, drip trays and drainage pipework.	As required As required 6 monthly

Table 3: Water systems cleaning and disinfection

Service	Task*	Frequency
Hot water services	Arrange for samples to be taken from hot water calorifiers/water heaters in order to note condition of drain water	Annually
	Check temperatures in flow and return at calorifiers/water heaters	Monthly ⁴
	Check water temperature after draw-off from outlets for 1 minute to ensure that 50°C has been achieved in sentinel outlets ^{1,2,5}	Monthly ⁴
	Visually check internal surfaces of calorifiers/water heaters for scale and sludge. ⁵ Check representative taps for temperature as above on a rotational basis	Annually
	Manual check to confirm secondary hot water recirculation pumps are operating effectively	Monthly
Cold water services	Check tank water temperature remote from in-coming ball valve and mains temperatures. Note maximum temperatures recorded by fixed max/min thermometers, where fitted	6-monthly ⁴
	Check temperature in sentinel outlets after draw-off for 2 minutes to establish that it is below 20°C ^{2,3}	Monthly
	Visually inspect cold water storage tanks and carry out remedial work where necessary. Check representative taps for temperature, as above, on a rotational basis	Annually
Mixed-temperature outlets	Check delivery temperature in accordance with D08	6-monthly
Showerheads	Dismantle, clean and de-scale showerheads and hoses	Quarterly, or as necessary
Sporadically-used outlets	Flush through and purge to drain, or purge to drain immediately before use without release of aerosols	At least twice weekly ⁶

Table 4: Summary operational checklist for hot and cold water services

*See paragraph 182 in the Health & Safety Executive’s Approved Code of Practice L8 for further guidance on tasks that should be undertaken.

Notes associated with Table 4:

1. For effective operation of hot water services, the minimum equilibrium temperature should be 55°C and be achieved within seconds.
2. For thermostatic mixing devices, temperatures should be measured at the inlet.
3. For satisfactory operation of cold water services, temperature equilibrium to below 20°C should be achieved well within one minute.
4. Temperatures should be continuously monitored by the BEMS. The extent of monitoring should not be restricted to the flow and return from calorifiers or inlets and outlets from cold water storage tanks. Extremities of piping networks should also be monitored.
5. Additional checks should be made on the hot water circulating system and systems using trace heating at distal points.
6. Risk assessment may indicate the need for more frequent flushing of outlets. It is preferable that this form part of the daily cleaning routine where appropriate. Alternatively, self-purging showers that discharge water to a drain prior to use and without the release of aerosols can be considered.

8. Other operational considerations

General

- 8.1 *Legionella* may colonise other areas where droplets of contaminated water of a size suitable for deep inhalation are generated. Such aerosol-generating plant and equipment should not be installed next to patient accommodation. Some patients may be particularly susceptible to infection.

Hydrotherapy pools, spa pools, whirlpool baths etc

- 8.2 Hydrotherapy pools, spa pools, whirlpool baths and decorative internal and external water features provide conditions that potentially favour the growth of *Legionella*. While there have been no reported cases of *Legionella* infections associated with hydrotherapy pools, there have been several outbreaks associated with spa pools or whirlpools. These types of pool are ideally suited to the proliferation and dissemination of *Legionella*. In addition, because of the small volume of water in circulation and the number of bathers (typically three to six people), spa pools can become a source of infection. Careful maintenance and chemical treatment is essential to maintain water quality. A log must be kept of water treatment and filter cleaning, and the results of tests for pH, free residual halogen and other treatment parameters. (For further guidance on hydrotherapy pools, see the Health Protection Agency's 'Hygiene for hydrotherapy pools'. For further guidance on spa pools, see the Health Protection Agency's 'Management of spa pools: controlling the risks of infection'.)

Spa pools 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.

Regular cleaning and disinfection after each use in accordance with manufacturer's instructions is recommended.

The Swimming Pool and Allied Trades Association (SPATA) and the Pool Water Treatment Advisory Group (PWTAG) provide advice on the operation of whirlpool baths.

- 8.3 All staff operating/maintaining this type of equipment should receive adequate training to ensure that appropriate safety procedures and effective water treatment regimes are adopted.

Maintenance for this equipment should be carried out in accordance with the manufacturer's recommendations.

Vending, chilled water and ice-making machines

- 8.4 See paragraphs 8.26–8.28 in Part A for guidance on installation of this equipment.

Where equipment is hand-filled, there should be clear instructions on the water used; it should be hygienically collected and decanted into the equipment from a clean vessel.

Note 15: Proprietary water containers for water dispensing machines should be returned to the supplier.

Chilled-water drinking fountains normally include a reservoir to assist in the cooling cycle; if machines are turned off, water quality can deteriorate.

Ice should not be allowed to stagnate in an ice-making machine's storage bin, but should be changed frequently.

For guidance on infection-control precautions with regard to ice-making machines, see Scottish Health Facilities Note 30: 'Infection control in the built environment'.

Maintenance for ice-making machines should be carried out in accordance with the manufacturer's recommendations. Care should be taken to ensure that the water supply to the ice-making machine is not subjected to heat gain.

Portable/room humidifiers

- 8.5 Designs should not include the use of 'portable' or 'room' self-contained humidifiers (having a water supply that is sprayed/atomised into the room space). In clinical/patient areas the decision to use this type of humidifier must rest with the infection control team. See Safety Notice NHSE SN(96)06: 'Evaporative type cooling fan'.

Non-potable water storage

- 8.6 Non-potable water is sometimes stored for emergency use (for example for fire-fighting purposes). These systems should be kept isolated from others by appropriate means that prevent back-siphonage and microbial contamination. They should be treated regularly using chlorine tablets or other form of treatment to ensure that water quality is maintained. This should be checked by total viable counts (TVC) sampling. See Part C of this SHTM for information on a standard testing protocol.

Deluge showers

- 8.7 Deluge showers are intended for use in an emergency where a staff member or a patient has suffered external chemical contamination. Similarly, there may be

other special outlets used for personal emergencies, for example eyebaths. These should not be installed on the end of lines and should be flushed in accordance with the recommendations in L8.

Trolley wash procedures

- 8.8 Trolley washing using high-pressure hoses is known to result in the generation of aerosols. The water supply should be taken from the potable system via a suitable air gap to prevent backflow contamination.

Lawn sprinklers and garden (or similar) hoses

- 8.9 In certain conditions, lawn sprinklers may retain stagnant water in the pipework/hose supplying the sprinkler head; they may also produce an aerosol spray. The pipework may be installed underground or via a flexible hose over ground. In either case it is very unlikely that they can be completely drained down after use or when not required; at certain times in the year the retained water may be at temperatures suitable for the colonisation by, and multiplication of, *Legionella*. There are evidence-linking cases of Legionnaires' disease with permanently installed systems using underground supply plumbing.

Vehicle washing plant

- 8.10 Vehicle washing is carried out either using a handheld pressure spray or by a 'frame wash' that consists of a bay containing a rectangular pipework frame fitted with several high-pressure sprays. In the latter case, this equipment should be flushed regularly.

Permanent hard-standing areas for vehicle-washing purposes should have an even surface to avoid ponding and have a slope or dish to a suitable drain.

Ornamental fountains

- 8.11 Ornamental fountains have been implicated in cases of legionellosis. They should not be situated under trees where fallen leaves or bird droppings may contaminate the water. Exposure to high winds should be avoided as they can disperse spray beyond the immediate confines of the basin/pond. The apex of the water column/jet should not exceed the distance to the nearest edge of the basin/pond, for the same reason. An overflow/outlet to a suitable drain should be provided for easy emptying and cleaning. Where possible, a permanently installed freshwater supply pipe with topping-up device should be provided. Their provision should be subject to a risk assessment, and appropriate action is required to minimise the risk. Any connection from a potable supply should be via adequate backflow protection.

The installation of an ornamental fountain or water feature on healthcare premises (for example a main entrance hall or courtyard) is not recommended.

Sanitary assemblies

- 8.12 Hoses used with sanitary assemblies such as variable-height baths should be provided with quick connectors to permit their removal for draining.

Wet fire systems

- 8.13 Wet fire protection systems have been implicated in outbreaks of legionellosis. All hose reels, sprinkler systems and wet risers should be isolated from the potable water supply by a method permitted by the Water Supply (Water Fittings) Regulations 1999. Many fire authorities are not in favour of local fire-fighting, preferring early professional intervention. It may, therefore, be possible to remove hose reels, thus avoiding their hazards. (Any redundant pipework should be cut back to the main including replacement of the branch tee with a straight coupling.)

Respiratory nebulisers

- 8.14 Respiratory nebulisers are intended for the delivery of a variety of medicinal products. They should be used strictly in accordance with the manufacturer's recommendations, and in no circumstances should they be used in association with domestic water supplies.

Flowers and plants

- 8.15 Consideration should be given to providing facilities for regularly disposing of wastewater and compost outside ward areas. This should not be provided in sluice rooms.

Summary checklist

- 8.16 A summary checklist for the systems covered in this Section, showing recommended frequency of activity, is given in L8.

9. Microbiological monitoring

9.1 Apart from situations where there are taste or odour problems, microbiological monitoring for TVCs is not considered to be necessary. However, many estates management staff continue to test for TVCs notwithstanding any conflict with the requirements of L8 as any obvious changes in monitored levels provide a useful rule of thumb early warning of possible emerging problems.

If performed for these purposes, the detection of low TVCs is not necessarily an indication of the absence of *Legionella*, but is an indication of the overall water quality and signifies a generally unfavourable environment for bacteria.

All microbiological measurements should be approved methods and/or be carried out by the appropriate United Kingdom Accreditation Service (UKAS)-accredited laboratories. Dip slides are not acceptable.

The procedures to be followed for sampling are set out in SHTM 04-01 Part C: TVC testing protocol.

10. Testing for *Legionella*

- 10.1 *Legionella* can exist within many systems at extremely low levels or below the threshold of decision making (100 cfu/litre). Up to now, in the absence of evidence of healthcare-associated infection, testing (which is complex and expensive) has not been considered necessary.
- 10.2 The infection prevention and control team, however, will need to consider the level of risk before deciding that *Legionella* testing is indicated. For example, testing may be required:
- when storage and distribution temperatures do not achieve those recommended under the temperature control regime and systems are treated with a biocide regime, a monthly frequency of testing for *Legionella* is recommended. This may be reduced as confidence in the efficacy of the treatment regime is established;
 - in systems where the control regimes are not consistently achieved, for example temperature or biocide levels (weekly checks are recommended until the system is brought under control);
 - when an outbreak is suspected or has been identified;
 - a Written Scheme is to be prepared indicating all sentinel taps. This is the responsibility of the designer;
 - on hospital wards with at-risk patients – for example those who are immuno-compromised.
- 10.3 As a minimum, samples should be taken as follows:
- from the cold water storage and the furthest outlet from the tank, on every loop;
 - from the calorifier flow, or the closest tap to the calorifier, and the furthest tap on the hot water service circulating system;
 - additional samples should be taken from the base of the calorifier where drain valves have been fitted;
 - additional random samples may also be considered appropriate where systems are known to be susceptible to colonisation.

The temperature control regime is the preferred strategy for reducing the risk from *Legionella* and other waterborne organisms in water systems. This will require monitoring on a regular basis. The recommended test frequencies for various outlets are set out in [Table 2](#) in [Section 7](#).

- 10.4 The sampling method for *Legionella* should be in accordance with ISO 11731: 2004. A UKAS-accredited laboratory that takes part in the Health Protection Agency's water external quality assessment (EQA) scheme for the isolation of *Legionella* from water should test samples (visit <http://www.hpaweqa.org.uk> for

further information). The laboratory should also apply a minimum theoretical mathematical detection limit of ≤ 100 *Legionella* bacteria/litre sample.

Note 16: Testing of water for *Pseudomonas aeruginosa* is only required if a very specific reason has been identified such as suspected or confirmed outbreak or a series of sequential cases, as guided by the Responsible Person (*Pseudomonas*).

10.5 Action following *Legionella* sampling in hot and cold water systems:

<i>Legionella</i> bacteria (cfu/litre)	Action required
>100 but <1,000	Either: If only one or two samples are positive, system should be re-sampled. If a similar count is found again, a review of the control measures and risk assessment should be carried out to identify any remedial action to be taken. Or: If the majority of the samples are positive, the system may be colonised with <i>Legionella</i> . Disinfection of the system should be considered, but an immediate review of control measures and risk assessment should be carried out to identify any other remedial action required.
>1,000	The system should be re-sampled and an immediate review of the control measures and risk assessment should be carried out to identify any remedial action, including disinfection of the system. Re-testing should take place a few days after disinfection and at frequent intervals thereafter until a satisfactory level of control has been achieved.

Appendix 1: Action in the event of an outbreak of legionellosis

- 1 **Legionnaires' disease is notifiable in Scotland under public health legislation.**
- 2 The Public Health Laboratory Service (PHLS) (now subsumed under the Health Protection Agency) defined an outbreak as two or more confirmed cases of Legionellosis occurring in the same locality within a six-month period. Location is defined in terms of the geographical proximity of the cases, and requires a degree of judgement. It is the responsibility of the Public Health Doctor for the declaration of an outbreak. The Public Health Doctor is appointed by the local authority under public health legislation.
- 3 Local authorities will have established incident plans to investigate major outbreaks of infectious diseases such as legionellosis. These are activated by the proper officer, who evokes an outbreak committee, whose primary purpose is to protect public health and prevent further infection. This will normally be convened to manage the incident and will involve representatives of the agencies involved. The Health & Safety Executive (HSE) or the local EHO may be involved in the investigation of outbreaks, their aim being to pursue compliance with health and safety legislation.
- 4 The local authority, Public Health Doctor or EHO acting on their behalf (often with the relevant officer from the enforcing authorities – either HSE or the local authority) may make a visit.
- 5 As part of the outbreak investigation and control, the enforcing authority may make the following requests and recommendations:
 - to shut down any processors that are capable of generating and disseminating air-borne water droplets and keep them shut down until sampling procedures and any remedial cleaning or other work has been done. Final clearance to restart the system may be required;
 - to take water samples from the system before any emergency disinfection is undertaken. This will help the investigation of the cause of illness. The investigating officers from the local authority/authorities may take samples, or require them to be taken;
 - to provide staff records to discern whether there are any further undiagnosed cases of illness, and to help prepare case histories of the people affected;
 - to cooperate fully in an investigation of any plant that may be involved in the cause of the outbreak. This may involve, for example:
 - tracing of pipework runs;
 - detailed scrutiny of all operational records;
 - statements from plant operatives and managers;

- statements from water treatment contractors or consultants.

Any infringements of relevant legislation may be subject to a formal investigation by the appropriate enforcing authority.

Emergency cleaning and disinfection of water systems

If a water system, other than a cooling system, is implicated in an outbreak of Legionnaires' disease, emergency treatment of that system should be carried out as soon as possible. This will involve disinfection as set out in Section 17 of Part A.

Appendix 2: Exemplar temperature test sheets

Hospital/site: Building: Department/ward:		Parameters: Sentinel outlets Cold water equilibrium <20°C within 2 minutes (see notes below) Hot water equilibrium >50°C within 1 minute (measured at outlet or inlet of blended temperature device) (see notes below)						
Room N°.	Room name	Mixing device type	Mixed temp. (°C)	Hot (°C)	Cold (°C)	Comments	Date	Initial
101	Main bathroom – Bath		43	55	18	C. Initially rose to 25°C	D/M/Y	ABC
	– WHB		41	55	18	– Ditto –		

A unique identification is required for each mixing device as well as identification of its type. Hot and cold water pressures also need to be measured and recorded for each mixing device together with all the test parameters from the in-service tests in Model Engineering Specification D08.

Note 17: The Health and Safety Executive’s Approved Code of Practice L8 permits a period of 1 minute to achieve an equilibrium temperature of 50°C. A minimum of 55°C may be required for the operation of suitable mixing devices required to provide ‘safe’ hot water at the upper limit of the recommended range. Hot water at 55°C is required in many cases for reasons of food hygiene or decontamination requirements, for example in kitchens and sluice rooms etc. In a properly balanced hot water circulating system, with the circulation taken close to the draw-off point, achieving temperature should be virtually instantaneous. (At a typical flow to a hand-wash basin of 4.5 litres/m, 1 minute to achieve temperature would indicate a 25m dead-leg of 15mm pipe.)

The Health and Safety Executive’s Approved Code of Practice L8 permits a period of 2 minutes to achieve an equilibrium temperature below 20°C. Achieving this minimum requirement would be indicative of an exceptionally under-utilised water system. (At a typical flow to a hand-wash basin of 4.5 litres/m, 2 minutes to achieve temperature would indicate a 50m dead-leg of 15mm pipe.)

Hospital/site: Building: Department/ward:				Parameters:				
				Year 1 test outlets Cold water equilibrium <20°C within 2 minutes (see notes below) Hot water equilibrium >50°C within 1 minute (measured at outlet or inlet of blended temperature device) (see notes below)				
Room N°.	Room name	Mixing device type	Mixed temp. (°C)	Hot (°C)	Cold (°C)	Comments	Date	Initial
120	Ward 4 Shower Hand-wash basin		41 41	57 57	17 17		D/M/Y	ABC
124	Kitchen – Sink – WHB		– 41	57 57	12 12			

A unique identification is required for each mixing device as well as identification of its type. Hot and cold water pressures also need to be measured and recorded for each mixing device together with all the test parameters from the in-service tests in Model Engineering Specification D08.

Note 18: The Health and Safety Executive’s Approved Code of Practice L8 permits a period of 1 minute to achieve an equilibrium temperature of 50°C. A minimum of 55°C may be required for the operation of suitable mixing devices required to provide ‘safe’ hot water at the upper limit of the recommended range. Hot water at 55°C is required in many cases for reasons of food hygiene or decontamination requirements, for example in kitchens and sluice rooms etc. In a properly balanced hot water circulating system, with the circulation taken close to the draw-off point, achieving temperature should be virtually instantaneous. (At a typical flow to a hand-wash basin of 4.5 litres/m, 1 minute to achieve temperature would indicate a 25m dead-leg of 15mm pipe.)

The Health and Safety Executive’s Approved Code of Practice L8 permits a period of 2 minutes to achieve an equilibrium temperature below 20°C. Achieving this minimum requirement would be indicative of an exceptionally under-utilised water system. (At a typical flow to a hand-wash basin of 4.5 litres/m, 2 minutes to achieve temperature would indicate a 50m dead-leg of 15mm pipe.)

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