



Scottish Health Technical Memorandum 2040

(Part 4 of 6)

Validation and verification

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

IMPORTANT NOTE LEGIONELLA

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

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

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

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

Disclaimer

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IMPORTANT NOTE: See front cover for status of SHTM 2040. SHTM 2040 must be read in conjunction with and as subordinate to HSC ACOP L8.



1. Introduction

- 1.1 The guidance contained in this part is applicable to new and existing sites, and is for use at various stages during the inception, design, upgrading, refurbishment, extensions and maintenance of a building.
- 1.2 The approach should be to remove all potential sources of seeding, growth and spread of legionellae. Where this ideal cannot be achieved in existing situations, steps should be taken to control and prevent legionellae by sound operational management.
- 1.3 The control of legionellae is a continuing responsibility. Effectiveness of precautionary measures should be continually monitored, and a continuing programme to ensure awareness should be devised. Although knowledge of legionellosis has improved markedly in recent years, there is a continuing misunderstanding about the method of dissemination. Many people are under the impression that cooling towers are the only source of legionellae in building service systems. All water systems are capable of colonisation by legionellae, and taps are just as capable of generating an aerosol as showers or indeed cooling towers.
- 1.4 The biggest risk is complacency, leading to the deterioration of water hygiene to the extent that an outbreak of the disease occurs.
- 1.5 Good practice design alone will not prevent outbreaks of legionellae.
- 1.6 The SHTM does not include advice on water supplies for clinical equipment such as dialysers, nebulisers and respiratory humidifiers, nor for sterile water services for pharmacy departments. Users of clinical humidifiers and nebulisers are reminded that sterile water, not tap water, should be used and that they should be emptied and cleaned thoroughly following each period of use. All equipment with water reservoirs should be stored dry. Water for any purpose should meet functional and local requirements, but users must recognise that any water system may provide a suitable environment for legionellae and other water-borne organisms and systems should therefore be designed to take account of this.

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2. Validation and verification considerations

Commissioning and testing of hot and cold water systems

- 2.1 The hot and cold water service systems should be commissioned and tested in accordance with BS 6700 and SHTM 2027; *Hot and cold water supply, storage and mains services*. BS 6700 details procedures to ensure that:
- materials and equipment installed comply with other British Standards and are not otherwise unsuitable;
 - the work is done entirely within the specification for the scheme;
 - the installation complies in every respect with current water byelaws and regulations and the requirements of British Standards;
 - all the requirements of current legislation are met, both during construction of the installation and when it is completed, particularly with regard to the Health and Safety at Work etc Act 1974.

NOTE: The Trust Infection Control Team should be advised of the testing. Further information on the role of the Infection Control team is given in the Scottish Infection Manual – Guidance on Core Standards for the Control of Infection in hospitals, health care premises and in the community interface (1998).

- 2.2 “As installed” drawings and operating/maintenance instructions must be supplied at the time of handover. Schematics will also be useful. Certified records of pressure testing and disinfection should also be made available.

Pressure testing

- 2.3 Pressure testing must be carried out before disinfection. Except where otherwise specified, testing of underground pipelines should be carried out in accordance with BS 5886, CP 312 and CP 2010-2, as appropriate for the pipeline material.
- 2.4 Open pipes should be capped and valves closed to avoid contamination. After pressure testing it will be impracticable to drain the system completely.



Disinfection

- 2.5 The system should be disinfected in accordance with BS 6700. Disinfection should be carried out within seven days of the system being brought into use unless:
- hot water temperatures are maintained;
 - cold water temperatures are maintained;
 - regular (every seven days) flushing is carried out.

NOTE: The contract should specify this for the period that the system is under the contractor's control. Refer to SHTN 2 for details.

- 2.6 Once filled, systems should not be drained unless full disinfection is to be undertaken before the system is brought into use again.
- 2.7 For design and build contracts, the brief must include the requirement that adequate certification of disinfection is provided by the contractor. On other contracts, tests must be witnessed and certified. During the post-handover period prior to occupation it is the client's responsibility to ensure system temperatures are maintained and regular flushing is carried out, or to implement full re-disinfection.

Temperature testing

- 2.8 These tests should be performed prior to contractual handover and bringing the system into use. Separate temperature measuring and recording equipment should be used, that is, independent of any building management system. It will be necessary to have systems fully operational and to simulate typical draw-off of water.

NOTE: Reference should be made to SHTM 2027 Part 4, 'Validation and verification' for guidance.

- 2.9 Tests should include:
- measuring the incoming water temperature at the main water meter;
 - testing the inlet, outlet and surface water temperatures of cisterns and cold water feed/header tanks for the hot water calorifiers. The temperature should not be greater than 2°C above that measured at (a);
 - testing the flow and return temperatures of calorifiers and boilers. These should not be less than 60°C and 50°C respectively;
 - testing the temperature at hot and cold water draw-off points, at sinks, wash-hand basins and baths, etc. A steady state temperature of

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between 50°C and 60°C at hot water draw-off should be reached within one minute. At cold water draw-off a temperature of not greater than 2°C above the temperature measured at (a) should be reached within one minute.

Discharge of waste water used during disinfection procedures within buildings

- 2.10 External bodies responsible for sewers should be informed before chlorinated water used for disinfecting an installation is discharged. Additional disinfection guidance is given in HSC(L8) 2000 The control of legionella bacteria in water systems – Approved Code of Practice and Guidance. It is preferable, therefore, to establish and agree procedures beforehand; this may simply involve the dilution of the discharge or de-chlorination.
- 2.11 When required, de-chlorination can be achieved using either sulphur dioxide or sodium thiosulphate (20 g of sodium thiosulphate crystals is required to de-chlorinate 500 litres of water containing 20 mg/l free chlorine).
- 2.12 If possible, it may be preferable to add the sodium thiosulphate to the chlorinated water at the point of discharge into the foul sewer rather than into systems. This will avoid the need for draining and washing systems of any residual chemical which would otherwise mop up any chlorine that may be present in the water.

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3. Cold water systems

General

- 3.1 The requirements for disinfection subsequent to flushing out to remove debris, etc, are essentially those given in BS 6700. Further guidance is available in 'A Guide to Pre-Commission Cleaning of Water Systems', issued by BSRIA, 1991, which deals with the design/installation considerations, system flushing and chemical cleaning. Background notes on disinfection by chlorine are given in SHTM 2040, 'Good practice guide'; Appendix 1.
- 3.2 Alternative disinfectants may be used provided satisfactory disinfection is achieved. The infection control team should be consulted.
- 3.3 Proprietary solutions of disinfectant should be used in accordance with the manufacturers' instructions and will have to take due regard of the requirements under COSHH and other health and safety regulations.
- 3.4 A suitable proprietary test kit should be used for site measurements of residual disinfection agents.
- 3.5 Disinfection should not be undertaken before materials, for example linings in cisterns, have fully cured.

Installations outside buildings

- 3.6 Pipework under pressure from the mains should be disinfected through an injection point and the disinfectant residual measured at the end of the pipeline. It is normal water industry practice to use a chlorine dose of not less than 20 mg/l (ppm) and, because the nature of the installation is likely to lead to unavoidable contamination, it is usual practice to leave the chlorine solution in the pipes for 24 hours before thoroughly flushing out with fresh water. Junctions which are to be inserted into existing pipelines should be disinfected prior to installation.
- 3.7 All disinfection of pipework under pressure from the mains must be carried out in accordance with the requirements of the local water undertaking. Failure to ensure close liaison between the contractor and the water authority during design, construction, pressure testing or commissioning could present a potential risk of back-siphonage of contaminated materials or chemicals into the public water supply. Site supervision to ensure compliance with any requirements specified by the local water authority is strongly recommended.

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Cold water installations within buildings

- 3.8 All cistern(s) should be internally cleaned to remove all visible dirt and debris. Cistern(s) and distributing pipework should be drained, filled with fresh water and then drained completely. The cistern(s) should then be refilled and their supply servicing valves closed. On re-fitting it is normal practice to add high doses of sodium hypochlorite to the water in the cistern(s), for example to give a calculated chlorine concentration of 50 ± 10 mg/l (ppm) in the water and leave the water to stand for one hour. Whatever disinfection method is used, the concentration should be adjusted if necessary. The use of a high dose ensures an adequate residual concentration to allow proper disinfection of the downstream services. Each tap or fitting should then be opened, progressively away from the cistern(s), and water discharged until the disinfectant is detected. Each tap or fitting should then be closed, and the cistern and pipes left charged for a further one hour. The tap(s) furthest from the cistern(s) should be opened and the level of disinfectant in the water discharged from the tap(s) measured. If the levels set in the British Standards are not achieved the disinfection process should be repeated.
- 3.9 As soon as possible after disinfection, the distribution pipework should be drained and thoroughly flushed through with fresh water and re-filled. Appropriate hazard warnings should be placed on the taps throughout the building during disinfection procedures.
- 3.10 After disinfection, microbiological tests for bacterial colony counts at 22°C and 37°C and coliform bacteria including *Escherichia coli* for drinking water should be carried out under the supervision of the infection control team to establish that the work has been satisfactorily completed. Water samples should be taken from selected areas within the distribution system. The system should not be brought into service until the infection control team certifies that the water is of potable quality.

Storage cisterns

- 3.11 Cold water storage cisterns are installed in the majority of hospital buildings/departments. A maximum of 24 hours total on-site storage capacity is recommended. The quantity of water stored should be carefully assessed in relation to the daily requirement in order that a reasonable rate of turnover is achieved. Storage of unnecessarily large quantities of potable water will result in low rates of turnover and a consequent deterioration in the quality of water. The storage capacity should be reduced where it is known or established that it is excessive and where it is practicable to do so. An example would be where there are two cisterns in parallel, one of which can be left empty and blanked-off (pipe sections should be removed). Alternatively, the steady water level in the cisterns should be lowered. This can be done most easily if the float controlling the water supply has a

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thumbscrew adjustment as prescribed in BS 1212: Part 2. The design capacity should not allow for future extensions.

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4. Hot water services

Hot water installations within buildings

- 4.1 Cold feed cisterns, hot water calorifiers, water heaters, direct-fired HWS boilers and distribution pipework should be disinfected in accordance with paragraphs 3.8 to 3.11; no heat source should be applied during the disinfection procedure, including final flushing.

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5. Evaporative cooling towers

General

- 5.1 The following paragraphs give general guidance on the operation and maintenance of cooling towers.
- 5.2 Before the identification of legionellae and its association with evaporative cooling systems, cooling towers were maintained for maximum service life. The aim of maintenance was to minimise fouling, thus ensuring optimum thermal efficiency.
- 5.3 Most evaporative cooling systems are uncomplicated in construction, simple in operation and usually located close to the refrigeration plant. Significant deterioration is possible, therefore, before plant inefficiency becomes evident.
- 5.4 It is essential that the utmost care and diligence is exercised in the operation and maintenance of cooling towers. The operation, maintenance and water treatment of evaporative cooling systems must be considered with regard to the associated health risks, in addition to operational efficiency.

Operating and maintenance documents

- 5.5 Operating and maintenance documents must be available for each installation and must be complete at the time of handover. If unavailable, operating and maintenance documents must be prepared by the user and should include the following:
- the design intent description, usually prepared by the designer and including the system function and its description. It should also include the design requirements in respect of water treatment regimen, flow rates, static and dynamic pressures, thermal capacities, system volumes, operating temperatures, control sensor locations, operating set points and all other relevant information. If commissioning information is not available it will be necessary to recommission the plant in order to prepare records of the operational parameters of the entire system;
 - a description of how the plant and system as a whole are set to work and how they are shut down;
 - a fault diagnosis schedule, description of the alarm/warning system and details of courses of corrective/diagnostic action in event of a fault condition. The schedule should also include a checklist and give guidance on checking possible causes of complaint originating from the occupier;

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- d. manufacturer's installation instructions and literature;
- e. spares information;
- f. operation instructions for individual items of plant;
- g. maintenance information for individual items of plant and maintenance frequencies;
- h. record drawings of the installation;
- i. plantroom and system schematic diagrams (framed copies should be mounted in the respective plantrooms);
- j. lubrication charts with frequencies;
- k. valve charts showing valve number, type and purpose and, where applicable, design flows/settings/pressure drops;
- l. logbooks.

NOTE: Schedule 3 of the Consumer Protection Act 1987 required that sufficient information is made available to the operator for him/her to safely operate the plant.

Logbooks

5.6 The purpose of a logbook system is to improve the efficiency and effectiveness of installation and maintenance, and also to provide a record of various tasks and observations so that the plant history can be reviewed at any time by the maintenance engineer. It will prove essential to the maintenance engineer in the operation of a planned plant maintenance scheme, and, if properly followed, will prevent unacceptable conditions developing as a result of ineffective maintenance.

5.7 The logbook should:

- a. identify the installation requiring attention, in this case an evaporative cooling system, and should describe its form, function and how it operates;
- b. record the results of the initial commissioning and any recommissioning so that observations made during maintenance checks can be compared;
- c. define the maintenance task or observation required and the frequency;
- d. provide for the recording of maintenance observations and results and for comments to be made in respect of any defect seen during the inspection. This facility should exist for each item of plant individually and for overall system observations;
- e. provide preliminary guidance on fault diagnosis and checking to assist with immediate on-site correction or adjustment;

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- f. provide for, and make reference to, any separate observation sheet required to record extensive or abnormal observations which cannot be noted on the routine inspection sheets;
- g. facilitate cataloguing and cross-referencing to other logbooks for plant/installations on the same site (for example, the refrigeration plant, the chilled water installation, the air-conditioning plant and the heat source).

Operational checks

- 5.8 This section of the SHTM is intended to assist maintenance staff in the planning of operational and functional checks. It identifies typical tasks and recommends observation frequencies. It is only a general guide, as it is not possible to cover all aspects which relate to a specific installation.

NOTE: As an aid to the preparation of a suitable logbook system, a sample logbook for an evaporative cooling system is included in SHTM 2040, 'Good practice guide'.

- 5.9 Details of operational and functional tasks must be drawn up for each site by the "nominated person". These, together with the completion of log sheets, will enable a proper historical record to be compiled of all works carried out and observations made.
- 5.10 Frequencies are indicated for initial guidance only, as they will vary to suit a particular site, its location, the design parameters and particular provisions, for example manual operation rather than automatic control methods.
- 5.11 The user's needs must be considered before commencing any operational or maintenance tasks. Where standby or dual facilities are not provided, the timing of these tasks must be carefully planned to minimise inconvenience.

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6. Air-conditioning and mechanical ventilation

General

- 6.1 Air-conditioning and ventilation plant and ductwork should be inspected at the access point(s) quarterly to see that it is clean and to report on its general condition.

Fresh air inlet

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

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



References

NOTE:

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

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

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

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

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

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

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