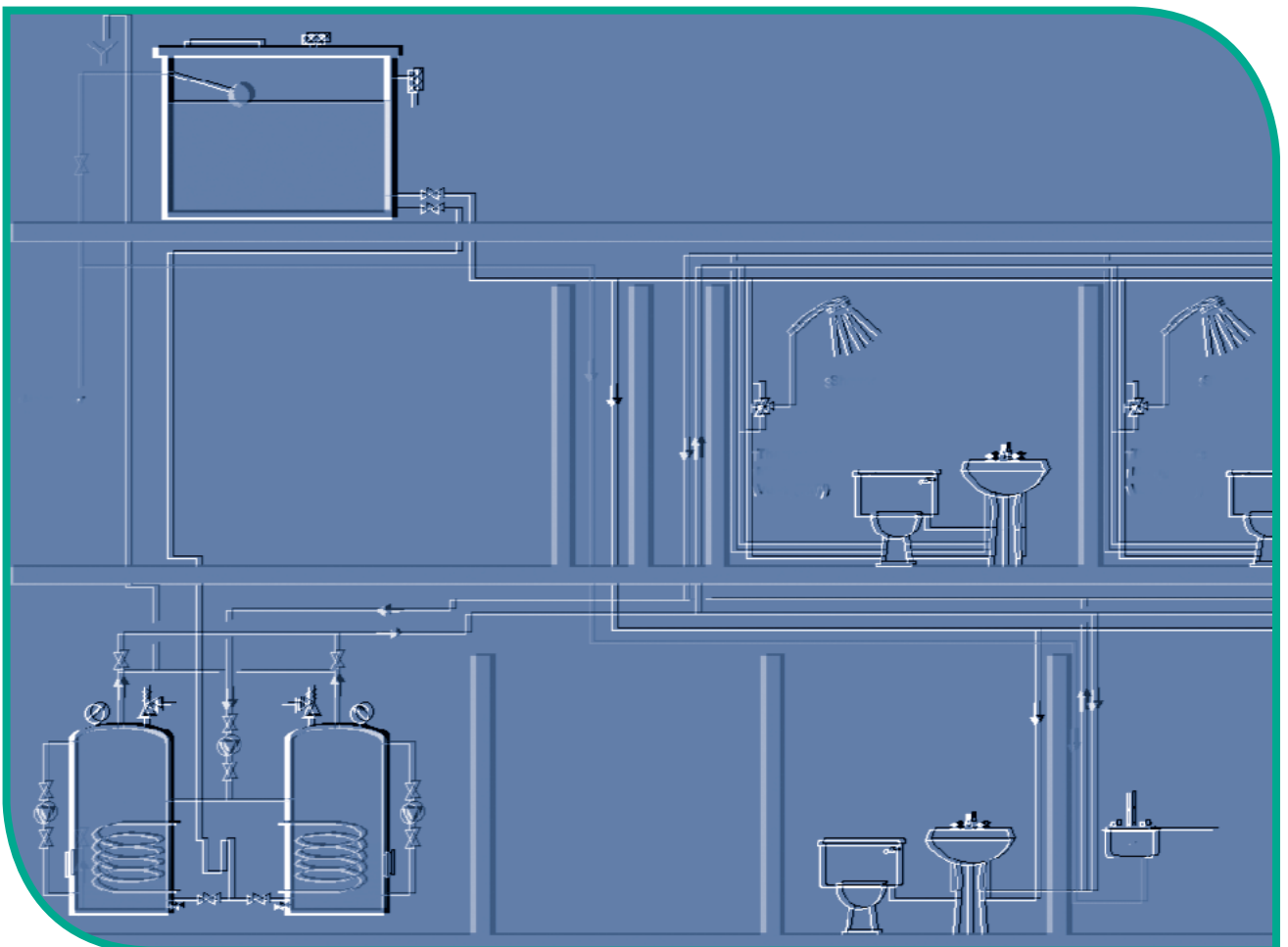




Department
of Health

Health Technical Memorandum 04-01: Safe water in healthcare premises

Part A: Design, installation and commissioning



Health Technical Memorandum 04-01 Safe water in healthcare premises

Part A: Design, installation and commissioning

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Executive summary

Preamble

This current review and update of HTM 04-01 is intended to move users of the document towards a holistic management of water systems via Water Safety Groups (WSGs), Water Safety Plans (WSPs) and other initiatives.

This version draws together and updates the previous guidance and includes recommendations for the safe management of water systems, via the integration of the principle of WSGs and WSPs (first introduced in the HTM 04-01 *Pseudomonas aeruginosa* addendum – published in March 2013), and how to manage and minimise the risks to health from various aspects, ranging from clinical risks, microbial and chemical contamination, changes to the water system, resilience of the water supply etc. It also introduces a stronger emphasis on staff competencies and the implementation of water hygiene awareness training.

Introduction

The development, construction, installation, commissioning 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 treatment and diagnostic purposes.

Interruptions in water supply can disrupt healthcare activities. The design of systems should 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 Health Technical Memorandum (HTM) gives comprehensive advice and guidance to healthcare management, design engineers, estate managers, operations managers, contractors and the supply chain 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

The current review and update of HTM 04-01 is intended to move users of the document towards a holistic management of water systems via WSGs, WSPs and other initiatives.

It has been written to promote good practice for those responsible for the design, installation, commissioning, operation and maintenance of water services in healthcare premises, by:

- highlighting the need for robust governance and management;
- outlining the remit of the WSG and how this relates to the provision of safe water in healthcare premises;
- outlining key criteria and system arrangements to help stop the ingress of chemical and microbial contaminants and microbial colonisation and bacteria proliferation;
- illustrating temperature regimes for sanitary outlets to maintain water hygiene;

- ensuring the safe delivery of hot water;
- outlining how the correct selection of system components and correct use by occupants can help preserve the quality and hygiene of water supplies;
- providing a point of reference to legislation, standards and other guidance pertaining to water systems;
- providing a basic overview of possible potential waterborne pathogens;
- giving an overview of some of the different water systems (including components) and their safe installation, commissioning and operation and maintenance;
- providing typical system layouts and individual component location;
- providing information on thermostatic mixing valve configurations, appropriate usage and maintenance requirements;
- identifying key commissioning, testing and maintenance requirements for referral by designers, installers, operators and management;
- identifying key commissioning, testing and maintenance requirements for referral by designers, installers, commissioners, operators and management.

Controlling waterborne pathogens

The guidance gives comprehensive guidance on measures to control waterborne pathogens. While *Legionella* control is, in the main, associated with poor engineering configuration and maintenance, with no evidence of patient-to-patient or patient-to-outlet transfer, *P. aeruginosa* may be transferred to and from outlets and the water from both patients and staff. Suspected *P. aeruginosa* waterborne infections require additional investigations to determine the source and interventions from infection control specialists and microbiologists. Therefore, a temperature control regime is the traditional strategy for reducing the risk from *Legionella* and for reducing the growth and

colonisation of other waterborne organisms within water systems. To prevent growth of *P. aeruginosa* and other waterborne pathogens, controls are necessary to manage the water system before and after the outlet.

As with all control measures, temperatures should be monitored at regular intervals to verify effective control.

Because of the complexity of hot and cold water distribution systems and the difficulty of maintaining a temperature control regime in some healthcare facilities, this guidance suggests that additional chemical, physical and other water control methods that have been shown to be capable of controlling microbial colonisation and growth may also be considered.

Main changes from the 2006 edition of HTM 04-01

- This 2016 edition of HTM 04-01 provides comprehensive guidance on measures to control waterborne pathogens such as *Pseudomonas aeruginosa*, *Stenotrophomonas maltophilia*, *Mycobacteria* as well as *Legionella*.
- This edition has been updated to align with the Health and Safety Executive's (HSE's) recently revised Approved Code of Practice for Legionella (L8) and its associated HSG274 guidance documents.
- The Addendum to HTM 04-01 published in 2013 (and now Part C of HTM 04-01) introduced the concept of WSGs and WSPs. Part B of the HTM now includes updated guidance on the remit and aims of the WSG and WSP.
- New guidance has been included on the hygienic storing and installation of fittings and components and on the competency of installers/plumbers working on healthcare water systems. The guidance also outlines that any person working on water distribution systems or cleaning water outlets needs to have completed a

water hygiene awareness training course.
An example course outline is included.

- Guidance on sampling techniques for, testing for, and the microbiological examination of *Pseudomonas aeruginosa* samples – originally in the HTM 04-01 Addendum – is now included in Part B to complement similar guidance on *Legionella*.

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Glossary and abbreviations

In addition to the definitions listed below, other definitions can be found in the Water Supply (Water Fittings) Regulations 1999; BS 6100; BS 8558; and BS EN 806.

Augmented care units/settings – There is no fixed definition of “augmented care”; individual providers may wish to designate a particular service as one where water quality must be of a higher microbiological standard than that provided by the supplier. While this document provides broad guidance, the water quality required will be dependent on both the type of patient and its intended use. Most care that is designated as augmented will be that where medical/nursing procedures render the patients susceptible to invasive disease from environmental and opportunistic pathogens such as *Pseudomonas aeruginosa* and other alert organisms. In broad terms, these patient groups will include:

- a. those patients who are severely immunosuppressed because of disease or treatment: this will include transplant patients and similar heavily immunosuppressed patients during high-risk periods in their therapy;
- b. those cared for in units where organ support is necessary, for example critical care (adult paediatric and neonatal), renal, respiratory (may include cystic fibrosis units) or other intensive care situations;
- c. those patients who have extensive breaches in their dermal integrity and require contact with water as part of their continuing care, such as in those units caring for burns.

Backflow – Flow upstream, that is in a direction contrary to the intended normal direction of flow, within or from a water fitting.

Biofilm – a complex layer of microorganisms that have attached and grown on a surface. This form of growth provides a niche environment for a wide range of microorganisms to interact and where the secretion of exopolysaccharides by bacteria will form an extracellular matrix for both bacteria and other unicellular organisms such as amoebae and flagellates to remain in a protected state.

Dead-leg – a length of water system pipework leading to a fitting through which water only passes infrequently when there is draw off from the fitting, providing the potential for stagnation.

Healthcare-associated infections (HCAI) – encompasses any infection by any infectious agent acquired as a consequence of a person’s treatment or which is acquired by a healthcare worker in the course of their duties.

Healthcare facility/building – all buildings, infrastructure, equipment, plant, embedded systems and related items that support the delivery of healthcare and services of all types, irrespective of their ownership or operation by third parties.

Healthcare organisations: organisations that provide or intend to provide healthcare services for the purposes of the NHS.

Point-of-use (POU) filter – a filter with a maximal pore size of 0.2 µm applied at the outlet, which removes bacteria from the water flow.

Redundant pipework (also known as blind end): a length of pipe closed at one end through which no water passes.

Thermostatic mixing valve: valve with one outlet, which mixes hot and cold water and automatically controls the mixed water to a user-selected or pre-set temperature.

Waterborne pathogen: microorganism capable of causing disease that may be transmitted via water and acquired through ingestion, bathing, or by other means.

Water outlet: (In this document) refers mainly to taps and showerheads, but other outlets, as indicated by risk assessments, may be considered important.

Water Safety Group (WSG): A multidisciplinary group formed to undertake the commissioning and development and ongoing management of the water safety plan (WSP). It also advises on the remedial action required when water systems or outlets are found to be contaminated and the risk to susceptible patients is increased.

Water safety plan (WSP): A risk-management approach to the safety of water that establishes good practices in local water distribution and supply. It will identify potential hazards, consider practical aspects, and detail appropriate control measures.

Water supply [to the healthcare facility]:

The water supplied can be via:

- the mains water supply from the local water undertaker;
- a borehole (operated by the healthcare organisation as a private water supply);
- a combination of mains water and borehole supply;
- emergency water provision (bulk tankered water or bottled drinking water).

Water undertaker – the role of a water undertaker is defined in a number of sections of the Water Industry Act 1991.

Wholesomeness: standards of wholesomeness are defined in section 67 of the Water Industry Act 1991. Separate legislation for public and private supplies sets out the prescribed concentrations and values for water and are detailed in the following legislation: the Water Supply (Water Quality) Regulations 2000 for water from a public supply; or the Private Water Supplies Regulations 2009 for water from a private supply.

List of abbreviations

COSHH – Control of Substances Hazardous to Health [Regulations]

CQC – Care Quality Commission

DWI – Drinking Water Inspectorate

EA – Environment Agency

EPDM – ethylene propylene diene monomer

HBN – Health Building Note

HSE – Health & Safety Executive

HSG274 Part 2 – The Health & Safety Executive's technical guidance on the control of Legionnaires' disease in hot and cold water systems

HTM – Health Technical Memorandum

POU – point of use

PWTAG – Pool Water Treatment Advisory Group

SHTM – Scottish Health Technical Memorandum

UKWIR – UK Water Industry Research

WRAS – Water Regulations Advisory Scheme

WSG – Water Safety Group

WSP – Water safety plan

0 Policy and regulatory overview: water safety and the healthcare estate

Introduction

0.1 The National Health Service (NHS) has a corporate responsibility to account for the stewardship of its publicly funded assets. This includes the provision, management and operation of an efficient, safe estate that supports clinical services and strategy.

0.2 This corporate responsibility is carried by all accountable officers, directors with responsibility for estates & facilities and their equivalents, chairs, chief executive officers and non-executive board members. Together they have a responsibility to enact the principles set out in this document, provide leadership and work together to implement the necessary changes to provide a safe, efficient high quality healthcare estate.

0.3 To achieve this, quality and fitness-for-purpose of the healthcare estate is vital. Health Technical Memorandum (HTM) 04-01 seeks to set out the quality of, and standards for, water safety in the healthcare estate.

0.4 A healthcare organisation's Water Safety Group (WSG) (see Part B) is pivotal in ensuring that decisions affecting the safety and integrity of the water systems and associated equipment do not go ahead without being agreed by them. This includes consultations relating to decisions on the procurement, design, installation and commissioning of water services, equipment and associated treatment processes.

0.5 The quality and fitness-for-purpose of the estate are assessed against a set of legal requirements and governance standards.

Adhering to the guidance outlined in this HTM will be taken into account as evidence towards compliance with these legal requirements and governance standards.

Compliance of the healthcare estate

0.6 Principles related to the safety of healthcare estates and facilities are enshrined in the Health and Social Care Act 2008 (Regulated Activities) Regulations 2014, specifically Regulation 12(2)(h) and Regulation 15 of the Act.

Note

There are numerous other statutes and legal requirements that NHS organisations, supporting professionals, contractors and suppliers must comply with. These are covered in the respective Health Building Notes (HBNs), Health Technical Memoranda (HTMs) and the [NHS Premises Assurance Model \(NHS PAM\)](#).

Health and Social Care Act 2008 (Regulated Activities) Regulations 2014

0.7 Regulation 12(2)(h) decrees that registered providers must assess:

- the risk of, and prevent, detect and control the spread of, infections, including those that are health care associated.

0.8 Appropriate standards of cleanliness and hygiene should be maintained in premises used for the regulated activity. DH (2015) issued '[The Health and Social Care Act 2008 Code of Practice on the prevention and control of infections and related guidance](#)' (the HCAI Code of Practice), which contains statutory guidance about compliance with regulation 12(2)(h) (see [paragraphs 0.15–0.17](#)).

0.9 Regulation 15 of the Act states that:

- (1) All premises and equipment used by the service provider must be—
 - a. clean,
 - b. secure,
 - c. suitable for the purpose for which they are being used,
 - d. properly used
 - e. properly maintained, and
 - f. appropriately located for the purpose for which they are being used.
- (2) The registered person must, in relation to such premises and equipment, maintain standards of hygiene appropriate for the purposes for which they are being used.

Note

The “registered person” means, in respect of a regulated activity, the person who is the service provider or a registered manager in respect of that activity.

A “service provider” means a person registered with the CQC under Chapter 2 of Part 1 of the Health and Social Care Act 2008 as a service provider in respect of that regulated activity.

Regulator requirements

0.10 The CQC independently regulates all providers of regulated health and adult social care activities in England. The CQC’s (2015) ‘Guidance for providers on meeting the regulations’ explains how to meet regulations 12(2)(h) and 15 outlined above.

0.11 Failure to comply with the Health and Social Care Act 2008 (Regulated Activities) Regulations 2014 and the Care Quality Commission (Registration) Regulations (2009) is an offence, and the CQC has a wide range of enforcement powers that it can use if a provider is not compliant. These include the issue of a warning notice that requires improvement within a specified time, prosecution, and the power to cancel a provider’s registration, removing its ability to provide regulated activities.

Examples of governance and assurance mechanisms arising from primary legislation (not exhaustive)

NHS Constitution

0.12 The Health Act 2009 places a duty on bodies providing and commissioning NHS services to have regard to the NHS Constitution. The Health and Social Care Act 2012 further applied this duty to the new bodies created by that Act or by amendments to the 2012 Act.

0.13 The NHS Constitution “sets out rights to which patients, public and staff are entitled”. It also outlines “the pledges which the NHS is committed to achieve, together with responsibilities that the public, patients and staff owe to one another to ensure that the NHS operates fairly and effectively”.

0.14 It commits the NHS to ensuring “**that services are provided in a clean and safe environment that is fit for purpose, based on national best practice (pledge)**”. In order to deliver on this pledge, the NHS should take account of:

- the NHS Premises Assurance Model (NHS PAM) – the NHS PAM identifies where the NHS Constitution needs to be considered and where assurance is required;
- national best practice guidance for the design and operation of NHS healthcare facilities (such as HBNs and HTMs).

The HCAI Code of Practice

0.15 A complex range of issues distinguishes healthcare environments from most other building types. One of the most important of these relates to the control of infection. Infection prevention and control teams should be consulted on any design decisions and a risk analysis conducted on the many issues of design involving water systems (see Health Building Note 00-09 – ‘Infection control in the built environment’). To manage and monitor the prevention and control of infections effectively, the HCAI Code of Practice requires a WSG and a water safety plan (WSP) to be in place.

0.16 The information outlined in HBN 00-09 follows the general principles given in the HCAI Code of Practice, which sets out criteria against which a registered provider will be judged on how it complies with Regulation 12(2)(h) of the Health and Social Care Act 2008 (Regulated Activities) Regulations 2014 on the prevention, detection and control of infections, particularly waterborne infections in relation to this document.

0.17 The law states that the HCAI Code of Practice must be taken into account by the CQC when it makes decisions about registration against the cleanliness and infection control requirement. The regulations also say that providers must have regard to the Code when deciding how they will comply with registration requirements. Therefore, by following the Code, registered providers will be able to show that they meet the requirement set out in the regulations. However, the Code is not mandatory. A registered provider may be able to demonstrate that it meets the regulations in a different way (equivalent or better) from that described in this document. The Code aims to exemplify what providers need to do in order to comply with the regulations.

Figure 1 illustrates how DH estates and facilities best practice guidance (such as the NHS PAM and HTMs) aligns with the statutory and policy framework. This guidance is fundamental to ensuring that NHS trusts are able to deliver on their commitments under the NHS Constitution and to comply with the CQC’s fundamental standards.

Never events

0.18 NHS England’s never events policy framework defines “never events” as serious, largely preventable patient safety incidents that should not occur if the available preventative measures have been implemented by healthcare providers. On the list of never events is [scalding of patients](#). The risk of scalding for vulnerable patients (children and young people, older people, and disabled people) is a particular problem in healthcare premises. HTM 04-01 provides guidance on reducing the risk of scalding.

Health and safety legislation

0.19 In the UK, the control of legionellae falls within the requirements of the Health and Safety at Work etc. Act. This Act also places duties on design teams, suppliers and installers to ensure that articles or substances for use at work are safe and without risks to health and that any information related to the article or substance is provided. The Management of Health and Safety at Work Regulations 1999 provide a broad framework for controlling health and safety at work. The Control of Substances Hazardous to Health Regulations 2002 (COSHH) provide a framework of actions designed to assess, prevent or control the risk from bacteria like *Legionella* and take suitable precautions.

0.20 The Health and Safety Executive’s (2013) Approved Code of Practice ‘Legionnaires’ disease: The control of legionella bacteria in water systems (L8)’ contains practical guidance on how to manage and control the

risks in water systems. The HSE has published complementary technical guidance in HSG274, which is split into three specific areas:

- Part 1 – evaporative cooling systems;
- Part 2 – hot and cold water systems; and
- Part 3 – other risk systems.

0.21 In addition, under the Reporting of Injuries, Diseases and Dangerous Occurrences Regulations (RIDDOR), there is a duty for employers to report any cases of legionellosis in an employee who has worked on hot and cold water systems that are likely to be contaminated with *Legionella*. Cases of legionellosis are reportable under RIDDOR if:

- a. a doctor notifies the employer; and
- b. the employee's current job involves work on or near cooling systems that are located in the workplace and use water; or work on water-service systems located in the workplace which are likely to be a source of contamination.

0.22 With regard to enforcement responsibilities, the Health & Safety Executive will take the lead with regard to incidents involving *Legionella*. See the 'Memorandum of understanding between the Care Quality Commission, the Health and Safety Executive and local authorities in England'.

Security

0.23 Accessibility to all plant and equipment should be limited to authorised personnel only (see NHS Protect's (2012) 'Guidance on the security and management of NHS assets').

Water regulations

0.24 As well as complying with the recommendations outlined in this document, the design and installation of the hot and cold water services, new or extended, in any healthcare premises should also comply with:

- the Water Supply (Water Fittings) Regulations 1999;
- [Defra's guidance](#) to the Water Supply (Water Fittings) Regulations;
- recommendations of the water suppliers in the Water Regulations Advisory Scheme's (WRAS) 'Water Regulations Guide', and
- any other requirements of the local water undertaker.

Water Supply (Water Fittings) Regulations 1999

0.25 These Regulations set legal requirements for the design, installation, operation and maintenance of plumbing systems, water fittings and water-using appliances. They have a specific purpose to prevent misuse, waste, undue consumption or erroneous measurement of water and, most importantly, to prevent contamination of drinking water.

0.26 These Regulations apply in all types of premises supplied, or to be supplied, with water from a water undertaker. They apply from the point where water enters the property's underground pipe, to where the water is used in plumbing systems, water fittings and water-using appliances. However they do not apply in premises that have no provision of water from the public mains supply.

Water Supply (Water Quality) Regulations 2000

0.27 These Regulations cover the quality of water supplied by water undertakers for public distribution which is intended for domestic purposes; these purposes include drinking, cooking, food preparation, washing and sanitation. Water supplied meeting these quality requirements is referred to as wholesome water.

Private Water Supplies Regulations 2009

0.28 These Regulations cover private sources of water intended for human consumption including drinking, cooking, food preparation or

other domestic purposes, such as boreholes and wells. Water meeting these quality requirements is referred to as wholesome water. These Regulations also place duties for monitoring and control of the quality of public water supplies where these are then further distributed to other users on separate premises by the water company's bill payer (this arrangement is often referred to as onward distribution).

0.29 Local authorities are the regulators for private water supplies and have a number of statutory duties under the Private Water Supplies Regulations.

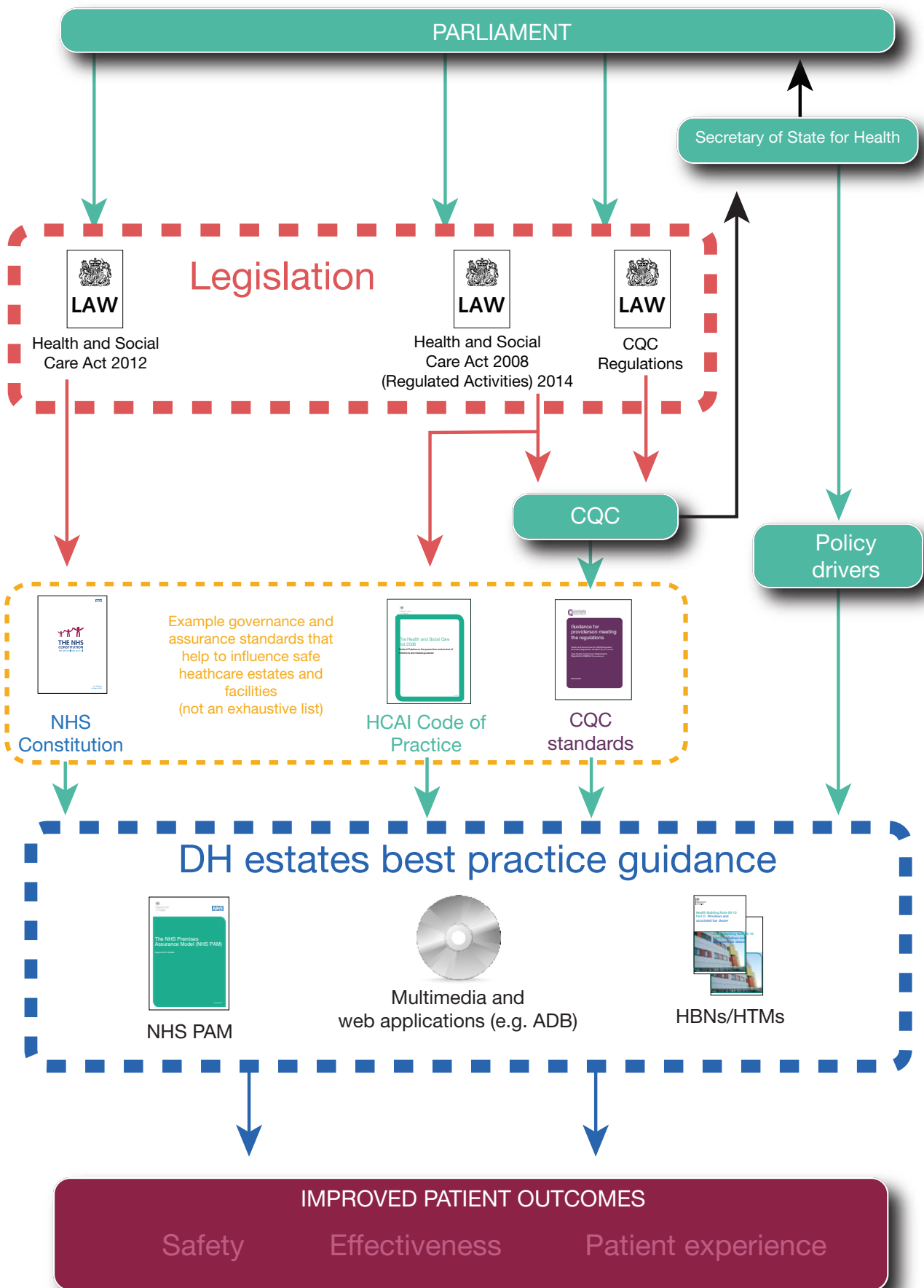


Figure 1 How best practice guidance on the safety and quality of healthcare estates and facilities fits in with the legislative and policy framework. (The statutes and mandatory requirements shown in this figure are not exhaustive. See Note after paragraph 0.6.)

1 Introduction to HTM 04-01

1.1 This edition of HTM 04-01 – 'Safe water in healthcare premises' supersedes HTM 04-01 – 'The control of *Legionella*, hygiene, "safe" hot water, cold water and drinking water systems' published in 2006.

1.2 This guidance has been revised to take account of HSE's revision of its Approved Code of Practice and guidance on regulations 'Legionnaires' disease: The control of legionella bacteria in water systems (L8)' and its complementary technical guidance HSG274.

1.3 This HTM gives comprehensive advice and guidance to healthcare management, design engineers, WSGs, estates 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.

1.4 The document comprises three parts. This part (Part A) outlines the principles involved in the design, installation and testing of the hot and cold water supply, storage and distribution systems for healthcare premises. Some variation may be necessary to meet the differing requirements for the various water undertakers. Part B covers operational management. Part C covers water safety in augmented care settings. HTM 04-01: Supplement – 'Performance specification D 08: thermostatic mixing valves (healthcare premises)' contains guidance on the on-site testing and commissioning of thermostatic mixing valves.

General

1.5 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.

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

1.7 The safe development, construction, installation, commissioning and maintenance of hot and cold water supply systems and associated systems and equipment are vital for public health.

1.8 Interruptions in water supply can increase the risk of microbial ingress especially if these result in depressurisation of the supply pipework. The design of systems should 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.

1.9 Measures to control the spread of microorganisms in healthcare premises include hand-washing but also the regular use of antimicrobial hand-rubs, and this can result in a significant reduction in the use of wash-hand basins. Under-use of taps encourages colonisation and growth with *Pseudomonas aeruginosa*, *Legionella* and other waterborne organisms. The design team should be aware

of this and, accordingly, consider how local infection policies with regard to hand hygiene and the use of antimicrobial hand-rubs might impact on the frequency of use of wash-hand basins and the volume of water being distributed (see also paragraphs 5.7–5.12 in Part B on the extent of utilisation).

Legislation, standards and guidance

1.10 As well as complying with the recommendations outlined in this document, the design and installation of the hot and cold water services, new or extended, in any healthcare premises should also comply with:

- a. the Water Supply (Water Fittings) Regulations 1999, Defra guidance and the recommendations of the water suppliers in the Water Regulations Advisory Scheme's (WRAS) 'Water Regulations Guide', and any other requirements of the local water undertaker;
- b. the HSE's Approved Code of Practice and guidance on regulations 'Legionnaires' disease: The control of legionella bacteria in water systems (L8)', which requires that sources of risk are identified and assessed and a written scheme of control is put in place in respect of controlling *Legionella* in water systems.

Notes

1. The Water Supply (Water Fittings) Regulations 1999 are set out – along with Defra's (1999) guidance (see [References](#)) and with the water industry's interpretation of these provisions – in the WRAS 'Water Regulations Guide'.

2. Special measures may have to be introduced to remove chloramines from mains water supplied to renal dialysis units. See guidance produced by the [Renal Association](#).

General requirements

1.11 Where new healthcare premises are planned or existing premises are to be altered or refurbished, the WSG should be consulted at the earliest possible opportunity and water risk assessments be completed for all projects. This will enable the total water hygiene requirements to be assessed in the planning stages, and appropriate action taken, including ensuring that any pressure testing, flushing and cleaning does not lead to stagnation or contamination before being placed into service. The risk assessment should be reviewed once the system is operational.

1.12 At all stages of the design, installation and commissioning of new or extended water systems, the design team should liaise and consult with the local WSG in a timely manner, give consideration to HTM 04-01 Parts B and C and incorporate all operational managements requirement into their design.

1.13 Design teams and installers of hot and cold water distribution systems are required by the Water Supply (Water Fittings) Regulations 1999 to notify the water undertaker of any proposed installation of water fittings and to have the water undertakers' consent before installation commences. It is a criminal offence to install or use water fittings without their prior consent. Liaison with the local water undertaker is strongly recommended at an early stage to avoid problems of compliance in the design. Further information can be found on the [WRAS website](#). See also [paragraphs 1.19–1.20](#).

1.14 All water fittings used in the construction of systems referred to in this HTM must comply with the requirements of the Water Supply (Water Fittings) Regulations 1999 (Regulation 4: "Requirements for water fittings") and if

The water industry

Water supply

Defra is the government department responsible for safeguarding the natural environment. This includes the protection of the aquatic environment, water resources and drinking water quality. It has established a number of regulatory authorities to oversee these areas. A company may be appointed to be a water undertaker by the Secretary of State under Section 6 of the Water Industry Act 1991, with a duty under this Act to develop and maintain an efficient and economical system of water supply (see Chapter 2).

Ten water and sewerage companies provide water and wastewater services for 99% of the population of England and Wales and drinking water to 75%. (A number of water supply companies provide drinking water to most of the remainder of the population.)

Regulatory authorities

The Water Act 1989 provided for the establishment of several regulatory bodies whose functions are now set out in the Water Industry Act 1991 and the Water Resources Act 1991 and are summarised below:

- a. the Office of Water Services (OFWAT), which regulates the prices set by the water companies, oversees the standards of service provision and protects the interests of water consumers. OFWAT also has ten regional WaterVoice committees that identify customer concerns, pursue them with the companies and report to the director-general of water services. OFWAT are overseeing changes to competition in the retail water market through the Open Water programme. These changes will allow businesses and other non-household customers to choose their supplier of water and wastewater services from April 2017. Retail services include things like billing and customer services.
- b. the Environment Agency (EA) regulates the quality and controls pollution of “controlled” waters (that is, most inland and coastal waters) and protects the water resources in England and Wales.
- c. the Drinking Water Inspectorate (DWI) regulates the quality of the public supply of drinking water in England and Wales.
- d. Local authorities regulate private water supplies.

required be in accordance with relevant British Standards and codes of practice appropriate to their use.

1.15 Where water is required to be wholesome, all non-metallic materials in contact with water should comply with the requirements of BS 6920. Many of the materials satisfactorily tested against this standard are listed by WRAS in the ‘Water Fittings and Materials Directory’ or by the DWI

in their published ‘List of Approved Products’. Some of these approval schemes also validate compliance against the mechanical performance requirements and where appropriate installation requirements set out in the Water Supply (Water Fittings) Regulations 1999. These fittings are considered compliant provided they are installed according to any conditions given with the approval. Additionally, fittings approved by BuildCert, NSF-WRC, Kiwa Watertec (UK) and WRAS, unless they specifically state they are not approved for

use under the Water Supply (Water Fittings) Regulations 1999, are deemed to meet these requirements. Currently no criteria exist to verify metallic materials. Only materials and fittings shown to comply with these regulations should be used (for example, registered in one of the approval lists given above).

Note

Organic materials increase the risk of microbial colonisation; materials should be chosen to minimise the risk where possible (see Chapter 3). See also Estates and Facilities Alert DH (2010) 03 – [‘Flexible water supply hoses’](#)

1.16 The provision of wholesome water to premises is governed by either the Private Water Supplies Regulations 2009 or the Water Supply (Water Quality) Regulations 2000 depending on how the water is supplied. Preserving water quality within premises is governed by the Water Supply (Water Fittings) Regulations 1999 (where water is supplied by a water undertaker), building regulations, approved codes of practice and technical standards intended to safeguard quality.

1.17 Only installers with the appropriate qualifications, regulatory knowledge and competence should be used to install and maintain water installations. There are seven Approved Contractors’ Schemes authorised through the Water Supply (Water Fittings) Regulations 1999. All seven schemes require appropriate qualifications and knowledge of the regulations as part of their membership criteria. The seven schemes are:

- the Association of Plumbing and Heating Contractors (APHC)
- Anglian Water’s APLUS
- the Chartered Institute of Plumbing and Heating Engineering (CIPHE)
- the Scottish & Northern Ireland Plumbing Employers’ Federation (SNIPPEF)
- Thames Water Approved Plumbing Scheme (TAPS)

- WaterMark
- the Water Industry Approved Plumbers’ Scheme (WIAPS)

1.18 In addition to plumbing installers, four schemes (APLUS, TAPS, WaterMark and WIAPS) operate sector memberships for specialist areas of work covering external water services (below ground pipework etc), catering equipment and point-of-use (chilled water) equipment.

1.19 The WaterSafe register holds details from all seven Approved Contractors’ Schemes for businesses who have registered and qualified plumbing installers (see also Part B).

1.20 A recognised benefit to using an Approved Contractor (including sector installers) is they can carry out some work without the need to provide advanced notification to the water undertaker and their work will be certified upon completion. A “work completed” certificate issued by a WaterSafe-recognised plumber provides a defence for property owners who are challenged by a water undertaker enforcing the Water Supply (Water Fittings) Regulations 1999 or during legal proceedings.

Hygienic installation and storage practices

1.21 Installers should adopt practices that reduce the likelihood of cross-contamination from tools, clothing or the environment. Separate clothing and tools used for other non-wholesome services such as sewerage and drainage systems should be kept separate and not used when working on hot and cold water systems.

1.22 Good working practices should be developed:

- to ensure that flushing and disinfection processes remain effective;
- to reduce the risk of seeding a system with anything that could lead to physical, chemical or microbiological

contamination;

- to reduce any damaging effects of the disinfection process through the need for multiple disinfection treatments.

Note

Guidance to principle of water supply hygiene can be found on [Water UK's website](#).

1.23 Only components and sub-assemblies that have been hygienically stored (for example, wrapped in bags and or original packaging) should be used (see also [paragraphs 3.42–3.44](#)). All components and sub-assemblies should be inspected before installation to ensure they are clean and free of defect. Efforts should be made to ensure debris and or contamination do not enter the hot and cold systems during construction and maintenance works.

1.24 Where contamination is suspected, measures should be undertaken to neutralise their effects (for example, flushing and disinfecting).

Storage

1.25 Items and components intended for installation in hot and cold water systems should be stored in clean, dry locations. Pipework valves and fittings etc should be stored on suitable racking and not on the floor. Larger items of plant that may have to be offloaded from delivery vehicles and delivered directly to their final location should be appropriately covered and protected from damage.

Water hygiene training

1.26 It is important that any person who works on hot and cold water systems or who is responsible for cleaning water outlets should have completed a water hygiene training course so that they understand:

- the need for good hygiene when working with water distribution systems and water

outlets; and

- how they can prevent contamination of the water supply and outlets.

Note

For new builds and refurbishments, it will be the contractor's responsibility to ensure that all operatives intending to work on the water system have completed water hygiene training covering associated risks of working practices and local requirements.

1.27 To ensure the delivery of safe wholesome water at all outlets and prevent contamination which may lead to a healthcare-associated infection, it is recommended that healthcare organisations implement a water hygiene training scheme which utilises local content where possible and is information appropriate for the target audience.

1.28 Consideration should also be given to integrating a health screening element into the training to help ensure those undergoing the training are not carriers of any waterborne diseases on the date of training and are aware of their responsibilities towards the water supply. It is important that individuals are aware of their duty to protect the health of patients, staff and visitors and that they are responsible for ensuring they inform their line manager if they come into contact with any disease that has the potential to cause harm.

1.29 As an example, the course should encompass the following topics (not exhaustive):

- organisational governance arrangements in relation to water hygiene and safety;
- familiarisation with local policies/ procedures in relation to the management and provision of water hygiene and safety;
- information on prominent waterborne

pathogens and their consequences;

- the ways in which water distribution systems and water outlets can become contaminated;
- the responsibilities of individuals to prevent the contamination of the water distribution system and water outlets and assisting in ensuring control measures in place are effective;
- how the safety of water can be maintained by good hygiene practices;
- system design;
- components/accessories (taps, TMVs);
- disinfection and cleaning equipment/materials;
- how to store and handle pipes;
- organisation-specific control measures;
- the impact of getting it wrong;
- role of persons being trained;
- personal hygiene along with dealing with clothing, footwear, cleaning equipment/materials, tools and storage when considering water hygiene (as applicable to each role).

Areas this HTM does not cover

1.30 Although many of this HTM'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 has not been defined, and the applicability will need to be considered in each case.

1.31 This HTM does not cover wet cooling systems such as cooling towers. Guidance on these systems is given in HSE's Approved Code of Practice and guidance 'Legionnaires' disease: The control of legionella bacteria in water systems (L8)' and HSG274 technical guidance Part 1.

1.32 While some guidance on other water-service applications is included, it is not intended to cover them fully. For:

- process waters used for laundries, see HTM 01-04 – 'Decontamination of linen in health and social care';
- endoscopy units, see HTM 01-06 – 'Decontamination of flexible endoscopes';
- primary care dental premises, see HTM 01-05 – 'Decontamination in primary care dental practices';
- renal units, see HBN 07-01 and HBN 07-02, the Renal Association's guidelines and ISO 13959 and 11663;
- sterile services departments, see HBN 13 – 'Sterile services department';
- hydrotherapy pools, see the PWTAG's '[Swimming pool water: treatment and quality standards for pools and spas](#)';
- spa pools, see HSE/PHE's '[Management of spa pools: controlling the risks of infection](#)';

Note

This document is currently being revised and will become HSG274 Part 4 – 'The control of legionella and other infectious agents in spa pool systems'.

- birthing pools, see HBN 21 – 'Maternity' and PWTAG's 'Swimming pool water: treatment and quality standards for pools and spas'.

2 Source of supply

General

2.1 The source of water supply to healthcare premises is by one or more service-pipe connections from the mains of a water undertaker. If the quantity and rate of flow is inadequate, or if the cost of providing the service connection appears to be uneconomical, alternative sources of supply such as boreholes or wells may be investigated or other water undertakers may be contacted.

2.2 The healthcare building needs could be met by using a private supply (see the Private Water Supply Regulations 2009) as an additional source to the water undertaker's supply provided the risk to health is fully assessed and the supply deemed acceptable for its intended purpose. In such cases, the water undertaker's supply should be the priority supply for drinking, culinary and special hygienic services. By limiting the use of the private supply to services not requiring the highest level of hygiene, the extent of treatment of the private supply may be reduced. Supplies used in this way should convey water through an entirely separate pipework system that is clearly labelled. Outlets served by the supply system should also be appropriately labelled.

Note

With regard to private water supplies, further guidance is given on [DWI's website](#).

2.3 Provision should be included for alternative water supply arrangements to meet an emergency, regardless of the source or sources of supply finally adopted (see HBN 00-07 – 'Planning for a resilient healthcare

estate'). Alternative arrangements would include a second service connection from the water undertaker or a private supply. In either case the alternative supply should not be vulnerable to the cause of loss of the original supply. Direct physical interconnection of pipework and valves of a water undertaker's supply with any private supply without adequate backflow protection is prohibited by the Water Supply (Water Fittings) Regulations 1999. The water quality requirements applicable to the main supply apply also to any alternative supplies.

2.4 The water undertaker and local authority must be advised if it is proposed to use any private supply as well as the water undertaker's supply, and advice should be sought on the limitations imposed in respect of break cisterns/RPZ (reduced pressure zone) valves and interconnections thereafter as required by the Water Supply (Water Fittings) Regulations 1999.

2.5 In England all water intended for human consumption is required by legislation to comply with the quality standards laid down in the Water Supply (Water Quality) Regulations 2000 and the Private Water Supplies Regulations 2009 (see [Appendix 2](#) for an overview of all UK water legislation). These regulations apply to water sampled at the point where the water is available for use and embrace not just drinking water and water used for washing, but also water used in the preparation of food and beverages.

2.6 The responsibility for enforcing the Water Supply (Water Quality) Regulations for public water supplies rests primarily with the DWI,

and for private supplies it rests with the local authority. In respect of public water supplies, the water undertaker has a duty to provide water that is wholesome at the point of supply to premises and to demonstrate – by monitoring – that the supplies meet the above standards. Water undertakers are also required to carry out risk assessments of each of its treatment works and connected supply in order to establish whether there is a significant risk of supplying water that would constitute a risk to human health. Using a risk-based approach, local authorities have a duty to monitor public health and in particular where affected by water supplies.

Supplies from a water undertaker

2.7 The following factors should be taken into consideration in the initial stages of the design:

- a. the water undertaker's requirements;
- b. water supply quality variations (see [paragraphs 2.11–2.15](#));
- c. the type of disinfectant residual and the variability in its concentration;
- d. maintaining water supplies in an emergency (see [paragraph 2.16](#));
- e. the estimated daily consumption, and the maximum and average flows required, together with the estimated time of peak flow;
- f. the location of the available supply;
- g. the quality, quantity and pressure required;
- h. the cold water storage capacity required;
- i. the likelihood of ground subsidence due to mining activities or any other reason;
- j. the likelihood of there being any contaminated land on site;
- k. the proposed method of storage and probable number and purpose of direct connections to pressure mains;
- l. the minimum and maximum pressures available at the service connection;
- m. details of the physical, chemical (including radionuclides) and microbiological characteristics of the water supply and scope of any possible variations in such characteristics;
- n. the possibility of an alternative service connection from some other part of the water undertaker's network, including pressure details;
- o. the water undertaker's contingency plans, which may result in disruptions to the quality or quantity of water supplied;
- p. the proximity of the supply pipework to wastewater pipes and the materials used for the supply pipework (plastic pipework is permeable to oil-based leaks such as diesels etc).

Note

Regulations require notification to the water undertaker of any proposed changes and additions to the water supply system in the premises. Prior to making any changes, a risk assessment should be carried out and audited as detailed in Part B. Further details can be found on the [WRAS website](#).

2.8 These initial design feasibility studies should normally reveal the need for any further treatment, pressurisation and storage of the water undertaker's supply to meet healthcare building requirements and enable an estimate of costs to be made.

2.9 BS EN 805, BS EN 806-1-5 and BS 8558 give further guidance on the procedures that should be followed when carrying out preliminary investigations in relation to new water supplies.

2.10 During the design stage, close collaboration with the water undertaker should be maintained, and consent must be sought on the final arrangements before proceeding with

the installation. These arrangements should include:

- siting of service connections, access chambers, metering, bypassing, flushing out, physical security of service connections, installation and provisions for the fire-and-rescue service, proximity to wastewater pipework etc;
- compliance with the Water Supply (Water Fittings) Regulations 1999.

Water supply quality variations

2.11 At different times of year or if an emergency affects a regular source of supply, water suppliers may use different sources of water to maintain supplies to an area, either separately or in combination by blending. While all the supplies will be wholesome and will meet the water quality standards set out in the Water Supply (Water Quality) Regulations 2000, the chemical composition of the water may vary.

2.12 One of the more common variations is in the hardness of the water, which is determined by the geology of the area from which the supply originates. By altering the source of the supply to an area, it is possible for the water to change from soft (for example total hardness of 50 mg/L as calcium carbonate (CaCO₃)) to hard (greater than 200 mg/L) or vice versa, causing users to notice differences with scaling in heating appliances, central heating and steam-raising plant, and with soap or detergent usage.

2.13 Water undertakers often access a variety of sources, which means that other possible changes may include temperature, taste or odour where the source changes between surface waters (such as rivers or reservoirs) and underground waters (such as borehole supplies). Differences may arise in dissolved iron, manganese or aluminium concentration and in the chlorine residual maintained in different supplies.

2.14 Healthcare organisations should liaise with their water supplier to find out whether it is likely that the quality of the water supplied may

vary, either due to planned operational changes to the water sources used at different times of year, or in the event of an emergency that prevents the use of the regular source of supply (see HBN 00-07 – ‘Planning for a resilient healthcare estate’). Where changes in the nature of supplies may be expected regularly, provision of water treatment facilities may be required within the healthcare facility to prevent complications occurring, such as scaling in central heating equipment, interference with sensitive medical equipment or adverse reaction from users.

2.15 Healthcare organisations should be aware of the type of disinfectant residual in the supply to their premises as it can have implications for choice of additional treatment. Under certain conditions, some water companies may also alternate the residual levels and type of disinfectant used (for example, chlorine and chloramine) between winter and summer.

Maintaining water supplies in an emergency

2.16 The [Security and Emergency Measures \(Water and Sewerage Undertakers\) Direction 1998](#) is a statutory document produced under the provisions of Section 208 of the Water Industry Act 1991. Water suppliers have a duty arising from it to make and revise plans for the provision of essential water supply and wastewater services at all times. The Direction includes the duty for water suppliers to give priority to the domestic needs of the sick, older people, disabled people, hospitals, schools, and other vulnerable sectors of the population.

2.17 Healthcare organisations should cooperate with water suppliers in developing plans to maintain essential supplies of water in the event of major incidents. These plans might include (see also HBN 00-07 – ‘Planning for a resilient healthcare estate’):

- The routine provision of public water supplies to the site from more than one water main, preferably using mains that are fed from different water supply

zones. Where mains are fed from different zones, particular care should be taken within the site to prevent direct interconnection and backflow between plumbing systems fed from the different supply zones.

Note: any arrangements designed-in should ensure there are no areas where water can stagnate (for example, dead-legs).

- Adequate storage cistern capacity and distribution arrangements within the healthcare facility to provide minimum volumes of water at the outset of a major incident to maintain hygiene and health for an initial period until other temporary arrangements can be introduced.
- The provision of facilities to connect to, and distribute water from, temporary storage cisterns such as pillow tanks at key locations within the site. Ground-level storage cisterns will require provision of booster pumps to either lift the water to existing storage cisterns or to distribute it directly through existing or temporary-site water mains.
- The provision of connection points to existing storage cisterns at suitable locations for delivery of emergency supplies of water, for example from tankers.
- Suitable distribution points for bottled water should be considered in the design process. This should work in conjunction with plans for the supply and distribution of bottled water for drinking to vulnerable patients and those unable to collect supplies from distribution points within the healthcare facility.

Private supplies

2.18 Private supplies independent of the water undertaker are governed by the Private Water Supplies Regulations 2009 and the Water Industry Act 1991. It is recommended that the Environment Agency (EA) and British

Geological Survey (BGS) are consulted before considering a private water supply. In some situations, a licence may be required from the (EA) if more than 20 m³/day is to be abstracted. Any borehole more than 15 m deep should also be registered with the BGS. If, for reasons of back-up or security of supply, there is a connection to the public supply (regardless of whether, or how often, it is used), the installations must comply with the Water Supply (Water Fittings) Regulations 1999. Private supplies should be registered with the local authority, which has the responsibility to maintain a register, risk-assess and monitor the wholesomeness of the supplies where these are used for domestic or food-production purposes.

2.19 The quality of water from a private supply is governed by the Private Water Supplies Regulations 2009. The standards are derived from the Drinking Water Directive and so are almost identical to those for public supplies. Reference should be made to the [DWI's private water supply guidance](#).

2.20 The EA keeps records and maps of sources of private water supply together with details of the geological strata and water-bearing characteristics of the area under its control.

2.21 The feasibility of such a private supply should be decided by comparing the capital costs (of the construction of works, including mains, pumping plant, treatment plant etc) and revenue costs (of electricity for pumping, water treatment chemicals, direct and indirect maintenance and associated management costs, regular water analysis tests etc) with the long-term cost of water supply from the water undertaker over the predicted life-cycle of the installation. Due consideration should be given to the long-term costs of a private supply, and account should be taken of potential deterioration in water quality and/or capacity of the private supply source.

2.22 Where consideration is being given to the use of a private supply in a healthcare

environment, specialist assistance should be sought to:

- a. confirm the integrity of the aquifer – that is, whether subject to surface water ingress/industrial effluent/radon/nitrates/pesticides etc;
- b. confirm the long-term quality of water and define requirements for water treatment;
- c. design and specify the works needed;
- d. carry out a full evaluation of the costs and practicability of a private supply compared to a connection from the water undertaker.

Other sources of supply

2.23 Greywater and rainwater should not be collected for use on, or in, healthcare premises.

Also see HTM 07-04 – ‘Water management and water efficiency’, which covers the use of greywater, rainwater and unwholesome borehole water.

3 Materials of construction

3.1 Any materials that come into contact with the water in a hot and cold water installation must comply with the requirements of the Water Supply (Water Fittings) Regulations 1999. To demonstrate compliance with these regulations, all non-metallic materials in contact with water should comply with the requirements of BS 6920. Currently no criteria exist to verify metallic materials. A number of lists exist for products and materials that have been assessed for compliance with the requirements and regulations (see [paragraph 1.15](#)). Further information on the selection of materials can be found in BS EN 805, BS EN 806-2, BS 8558 and BS 6920-1.

3.2 Materials of construction should be selected to take account of water quality and its potential corrosive properties. The water undertaker should be asked to provide details of any specific requirements and variability from standard conditions.

Note

Consideration needs to be given to substances that may be present in many rubber compounds, and are also occasionally associated with non-metallic materials such as plasticised (softened) plastics, which can provide nutrients for *Pseudomonas aeruginosa* growth. Most non-metallic materials meeting the full requirements of BS 6920-1 should not enhance microbial growth. Where oxidising chemicals are used, they may exacerbate leaching.

3.3 Water supplied by the water undertaker, although remaining wholesome, will nevertheless differ chemically. Some waters are slightly acidic while others are slightly alkaline, and this affects the choice of materials for pipes, fittings and cisterns. The water undertaker also blends water and, accordingly, the character of the water supply may vary from time to time. It will therefore be necessary to consult the water undertaker for advice on what materials should be avoided.

3.4 The choice of materials for piping and fittings should also take into account the nature of the soil in which the piping is to be laid. The materials selected should, where necessary, resist possible corrosion both inside and outside. The extent, if any, of anti-corrosion treatment of the outside of the piping will depend on the analysis of the soil. The advice of the water undertaker should be sought on the protective measures usually adopted in the area.

3.5 Corrosion (or erosion) can be caused by the motion of water when it is in a turbulent state and thus subject to rapid changes in pressure. At moments of low pressure, minute vapour or gas bubbles may be released which collapse with implosive force the moment the pressure is increased. The collapse of such bubbles on a metallic or concrete surface will quickly cause deep pitting or erosion of that surface. The design team should therefore avoid high velocities, the sudden increase of pressures or pulsating pressures.

3.6 Metallic piping should not be installed in contact with corrosive building products and materials.

3.7 Corrosion may result from galvanic action where dissimilar metals are connected. Dissimilar metals should therefore be avoided as far as practicable, but if that is not possible, it should be determined that deterioration through galvanic action is unlikely to occur, or effective measures should be taken to avoid deterioration.

3.8 The materials generally used for the conveyance of water in healthcare premises are copper, steel, stainless steel and plastics. Lead is no longer allowed under the Water Supply (Water Fittings) Regulations 1999 for pipework or solders. Lead-free solders only should be used (see also [paragraphs 3.33](#) and [5.1–5.5](#)).

3.9 Substances leached from materials of construction of pipes, cisterns or other water fittings in contact with water must not adversely affect the quality of water stored or drawn for domestic or food-production purposes (Water Supply (Water Fittings) Regulations 1999).

3.10 Direct gas-fired water heaters are particularly prone to corrosion and scale formation, and the inside of these heaters should be provided with suitable linings to limit these effects.

Steel pipes and fittings

3.11 Where steel is used for bolts, nuts and slip-on couplings, adequate protection from corrosion should be provided. This usually takes the form of bitumen coating, but bitumen is not permitted in contact with water required to be wholesome (that is, to be used for normal domestic or food-production purposes).

3.12 Unless adequately protected, steel is liable to corrosion both internally and externally, and therefore should not be used untreated. Steel piping is usually supplied zinc-galvanised, but depending on the character of the water to be conveyed, it may be necessary to use piping with an internal coating of either epoxy resin or polyurethane lining, which requires special application techniques (see the Water Industry Specification WIS 4-02-01 –

‘Operational requirements: in situ resin lining of water mains’).

3.13 External protection for piping may consist of bitumen or tar-wrapping with reinforcing layers of fibreglass or a plastic cladding.

3.14 Where screwed steel piping is used, any threads exposed after jointing should be painted or, in the case of underground piping, thickly coated with a bituminous compound or other suitable composition to prevent corrosion.

3.15 If the soil is corrosive, the pipes should be additionally protected by means of bitumen and fibreglass cloth wrappings.

3.16 Screwed steel piping is jointed with screwed socket joints, using fittings of wrought iron, steel or malleable cast-iron. A jointing compound or tape, which may be one of the many proprietary makes, should be used according to the manufacturer's instructions. Compounds containing red lead must not be used because of the danger of contamination of the water. Jointing compounds should not support microbial growth, should comply with BS 6920-1, and should have been assessed and shown to be appropriate (for example, suitable approvals) for the intended application (see [paragraph 1.15](#)). Care should be taken to remove any burr from the ends of pipes and to prevent the entry of excess jointing material. Steel piping may also be jointed with screwed flanges of steel or cast-iron or with mechanical couplings.

Stainless steel

3.17 Stainless steel is being increasingly used in hot and cold water service systems. Reference should be made to Chapter 3 of SHTM 04-01 Part E – ‘Alternative materials and filtration’ and also the British Stainless Steel Association’s (2002) ‘Operational guidelines and code of practice for stainless steel products in drinking water supply’.

Copper pipes and copper/copper alloy fittings

3.18 Copper in general is resistant to corrosion. Unless resistant to dezincification, brass fittings should not be used where water conveyed is capable of dissolving undue amounts of zinc from the fitting. External protection from corrosion for buried pipework may be obtained by using copper tube with a factory-applied polythene sheath. Dezincification-resistant material should be used for fittings that are concealed or inaccessible, for backflow prevention devices, and for temperature and pressure-relief devices on heating systems. Copper piping should conform to BS EN 1057 as appropriate for underground or above-ground installations.

3.19 Fittings should comply with the requirements of BS EN 1254-1–6. Copper piping may be jointed by means of compression joints or capillary joints or push-to-connect fittings made from copper or copper alloys. Effective capillary joints in copper pipes can be achieved if care is taken in their construction. For underground use, when using fully annealed copper piping, the fittings should be a manipulative joint.

3.20 Lead-free materials should be used in the formation of all wholesome water pipe capillary joints.

Solder and flux

3.21 When soldering copper tube and fittings, refer to WRAS Information and Guidance Note 9-04-02 – ‘Solder and fluxes’ (see also [paragraph 3.33](#) on the prohibition of lead solder). If wax-based soldering flux is used, it should be used sparingly and be compliant with BS 6920. It poses a risk of bacterial contamination to the system, which can be difficult to eradicate.

Plastics

3.22 Most water systems operate at modest pressures and at a maximum temperature of

70°C. Such operating conditions are within the specified performance of plastics being produced in a range of sizes and costs suitable for healthcare premises. Most ranges of plastic pipework are not suitable for renal dialysis applications, where water at a temperature of 95°C is regularly circulated for sanitation and there is an incompatibility with reverse osmosis-treated water used in renal dialysis.

3.23 Advantages of plastic include corrosion resistance, lightness of weight, ease of handling and fully weldable systems.

3.24 Disadvantages include poorer mechanical strengths than metals, greater thermal expansion (about seven times that of copper), low temperature and shorter distances between pipe supports. The latter can be alleviated by employing the manufacturer’s longitudinal tray that extends the distance between supports.

3.25 Materials in common use for plastic pipework are medium-density and high-density polyethylene, the latter being stronger. Unplasticised polyvinyl chloride (uPVC) pipework has mainly been replaced by the stronger chlorinated polyvinyl chloride (PVC-C). PVC pipes to BS 3505, BS EN 1452 (parts 1–5) and BS 3506 are of a rigid material that has a greater tensile strength than polyethylene, but is less resistant to fracture. These materials are less susceptible to frost damage than metal pipes. Although freezing is unlikely to damage the pipe, it will result in interruption of supply, and subsequent leakage from joints may occur.

3.26 Polyethylene pipes are generally not susceptible to corrosion from either the water or the ground in which they are laid. However, they are not recommended in any soils contaminated with organic materials likely to permeate the plastics and taint the water such as coal gas, methane, oils, petrol or other organic solvents. However, plastics pipes incorporating a protective barrier (barrier pipes) may be used if tested to Water Industry Specification WIS 4-32-19 – ‘Polyethylene pressure pipe systems with an aluminium

barrier layer for potable water supply in contaminated land'. Further advice is available from the report by UK Water Industry Research (UKWIR) "Guidance for the selection of water supply pipes to be used in brownfield sites" <https://www.ukwir.org/site/web/content/reports/reports>.

3.27 It is essential to consider the locality of exposed plastic pipes to ensure that there is no likelihood of mechanical damage and effects of UV light; otherwise suitable protection around the pipe will be necessary. Plastic piping should be adequately supported and incorporate adequate means of accommodating expansion, bearing in mind that plastic pipes have a much greater coefficient of thermal expansion than metal pipes.

3.28 Methods of jointing employed include compression joints with insert liners, flanged, screwed and fusion-welded joints, as well as joints of the spigot and socket type. The method of jointing employed is dependent on the bore of the pipe and the applied internal pressure, and should be in accordance with the manufacturer's recommendations. A competent fitter who has been trained under an approved scheme should make joints.

3.29 Manufacturers tailor plastics used in pipes and fittings for specific applications and factors such as pressure, temperature and life-cycle analysis, which take into account specific water qualities inclusive of oxidation levels. Manufacturers' recommendations should be strictly followed when selecting appropriate pipes and fittings for a particular application. Assumptions should not be made that a pipe/fitting suitable for one application can be used in any application. For example, pressure requirements or the suitability for cold water use may not mean it has been designed and tested for hot water use; equally suitability for one high temperature application may not be suitable for another high temperature application. Incorrect selection may not be covered by the manufacturer's warranties and may result in shortened service life.

Multi-layer pipes

3.30 Multi-layer pipes are becoming more available and may consist of plastics or metal layers, for example aluminium pipe with an external and internal sheath of plastic. BS EN ISO 21003 should be used to demonstrate the performance of such pipes and fittings before considering their selection.

Iron pipes and fittings

3.31 Ductile iron is little used nowadays, but it may be encountered in the course of a refurbishment project or in areas of hostile soil conditions. Cast-iron has good resistance to corrosion, and this is further enhanced if the casting skin on the metal is still intact. Although ductile iron pipes are thinner than grey iron pipes, their resistance to corrosion is at least as good, and there is evidence that they tend to be more resistant. In assessing the life expectancy of ductile iron pipelines, account should be taken of any intended higher operating pressures that may be used or permitted.

3.32 In made ground containing ashes and clinker, or in certain natural soils such as aggressive waterlogged clays, and saline and peat marshes, additional external protection may be required. This may be provided by the use of protective coatings such as bitumen or coal-tar sheathing, by protective tapes, by loose polythene sleeving or, in certain circumstances, by concrete. Water undertakers are using more composite materials in pipework to overcome the risks.

Lead

3.33 The Water Supply (Water Fittings) Regulations 1999 prohibits the use of lead in wholesome and domestic water systems. No new lead piping or lead solder should be installed or used in any building. In the unlikely event of any lead pipework being discovered in existing healthcare premises, it should be removed as soon as practicable.

Concrete

3.34 Protection of concrete pipes may be required against sulphate and acid attack. The minimum size available in concrete pipework is 150 mm diameter, and therefore its practical use for healthcare premises is very limited.

3.35 Standard concrete pipes may be used when not subjected to internal pressure. Pre-stressed concrete pipes are available as pressure pipes, but only in larger sizes.

Asbestos cement pipes and fittings

3.36 Asbestos cement pipes generally withstand corrosion but may have to be protected when laid in soil of high sulphate content. If iron fittings are used, both internal and external protection should be applied.

3.37 Specialist advice should be taken if work on materials containing, or suspected of containing, asbestos is to be carried out. See also the EA's regulatory position statement 008 – 'Leaving decommissioned pipes in excavations'.

Flexible water supply hoses

3.38 Flexible hoses (also known as tails) have become a convenient method of connection between hard pipework and sanitary fittings and/or equipment. They typically comprise a steel-braided outer sheath with a synthetic lining.

3.39 There have been reports of high counts of *Pseudomonas* and *Legionella* in water samples taken from outlets fed by flexible lined hoses due to colonisation of the lining. Materials such as ethylene propylene diene monomer (EPDM) rubber may be susceptible to microbial colonisation. Careful selection of materials for their suitability for wholesome water systems is needed and they should be verified before being used.

3.40 New lining materials are now available such as polyethylene (PE), cross-linked polyethylene (PEX), linear low-density polyethylene (LLDPE) and post-chlorinated

PVC (PVC-C) and should be compliant with BS 6920 (see [paragraph 3.1](#)).

3.41 Flexible hoses should be used only for the following applications:

- to allow for vibration of equipment;
- to accommodate vertical displacement of high and low baths and sinks;
- to facilitate essential maintenance and access of bespoke equipment when no alternative is available.

Note

Where fitted, flexible hoses should be kept as short as possible and be kink-free so as to not affect flow.

Cleanliness and hygiene

3.42 All pipes, fittings, valves, sub-assemblies, calorifiers, cisterns etc intended to form part of the hot and cold water service installation should be supplied to site cleaned, free from waterborne pathogens, particulate matter and other residues. All items should be identified as intended for water supply services.

3.43 Pipes should be capped at both ends and suitably wrapped in bundles. Pipe joint fittings should be suitably bagged or capped and boxed. Larger items of plant such as pumps, calorifiers etc should have connections blanked with plugs or flanges.

3.44 Where possible, leak-testing should be carried out using nitrogen or medical quality compressed air or oil-free dry compressed air. This must be carried out by competent personnel (see HSE's GS4 – 'Safety requirements for pressure testing'). Where water is used for test purposes, it should be supplied from a wholesome source. For pre-assembled items such as bathroom pods, all moisture should be removed before being delivered to site and be packaged in such a way as to prevent contamination from waterborne pathogens during transport and storage.

4 Water treatment and control programmes for hot and cold water systems

General

4.1 When control of the microbiological safety of water systems cannot be achieved throughout the system by maintaining temperatures, additional control strategies should be considered to reduce the risk of waterborne infection. Commonly used strategies include the use of filtration, pasteurisation or the use of biocides. Any biocide added to a water system should be dosed at the lowest concentration required to protect patient safety and ensure no undue exposure of individuals to harmful concentrations (refer to the COSHH Regulations 2002).

4.2 Some biocides require the system to be taken off-line before treatment; in these cases, users should take great care to ensure water cannot be drawn for bathing, food preparation or drinking until the treatment chemical has been completely flushed from the system. The WSG should ensure that measures are taken to protect vulnerable patients such as those in renal dialysis units.

Note

When building a new haemodialysis unit, a separate mains water supply should be considered so that other areas of the healthcare facility may be dosed without affecting the RO plants. If this cannot be achieved and biocides are required, appropriately monitored control systems need to be in place.

4.3 A biocidal product for this purpose is defined as one which controls harmful or

unwanted organisms within water systems. The EU Biocides Regulation 528/2012 regulates the use of biocidal products that have been proven to be safe and effective for their intended uses. Within the EU, suppliers of active substances must be registered and as such there is a list of registered products and suppliers (Article 95 list). Within the UK the HSE is the designated authority for overseeing [implementation of biocides](#).

4.4 The Drinking Water Directive, transposed into law in the Water Supply (Water Quality) Regulations 2000 (as amended) for public water supplies, and in the Private Water Supplies Regulations 2009 for private supplies, sets out additional separate requirements for products and substances that may affect water intended for human consumption. This ensures that treatment chemicals suitable for use in the preparation and distribution of drinking water have no adverse effects on the quality of water intended for human consumption. The DWI publishes [a list of products approved for treatment of drinking water supplies](#).

4.5 The WSG should be satisfied that the design, specification and commissioning will enable the water treatment systems to achieve the required biocide concentrations throughout the system at all times to minimise microbial risk. The impact of treated water on the materials and components of the existing system should be taken into account along with advice from the necessary suppliers and installers. Within a healthcare facility, the detrimental effects of biocidal treatment, such as corrosion of metal components and deterioration of plastics and elastomers, should be taken into consideration as biocide use may

shorten the lifespan of particular components. Complete flushing of the system should be carried out and verified before being brought into use. Concentrations and stand times should be assessed and controlled.

4.6 Where treatment systems produce a discharge as part of the process, an appropriate air break to the drain must be installed such as a type AA air gap or an air-break-to-drain device in accordance with BS EN 1717 clause 9.

Biocidal treatment

Note

Any biocidal treatment system should not adversely affect the materials of construction.

4.7 In addition to maintaining a temperature control regimen, there may be occasions where additional biocidal treatment is required for the effective control of *Legionella* and other opportunistic waterborne pathogens. However, the selection of suitable treatment is complex and depends on a number of parameters, and the chosen biocide should be properly managed. This is particularly the case with cold water services compared with hot water services where, with the benefit of circulation, water is returned to the calorifier/water heater and is then pasteurised. However, it should be taken into consideration that effective concentrations of some biocides are difficult to achieve in hot water systems due to gassing off. For water intended for consumption, the biocide concentrations must not exceed prescribed concentrations for drinking water.

4.8 Where biocides are used to control microbial growth in water systems, as with the temperature regimen, meticulous control and monitoring programmes should be in place if they are to be effective. However, careful consideration should be given to any equipment that is connected to the water system that may be affected by the application

of a biocide (for example, renal departments, haemodialysis units and neonatal units).

4.9 To meet legislative requirements, biocides used for water treatment must:

- contain an active substance approved for that use (subject to product-type) under the Biocidal Products Regulations (or be under review for the relevant product-type) and the biocidal product consisting of or containing that substance must be authorised for the product-type (subject to the transitional arrangements while the active substance review is ongoing);
- be suitable for drinking-water use.

4.10 The WSG should be actively involved in the decision-making process and should involve consultation with the water undertaker to ensure the suitability of biocidal products for their intended application.

4.11 There is no single water treatment regimen that is effective and appropriate in every case, and each system has both merits and limitations. The implementation of a biocide regimen together with maintaining temperature control requires constant vigilance to ensure the safety of particularly vulnerable patients in healthcare premises. For example, dedicated treatment and supply arrangements may be required for renal and haemodialysis units or for making up infant feeds where concentrations of biocides in the water would be harmful to patients.

4.12 Each water treatment system should be validated and monitored to demonstrate that the correct biocide concentration is being achieved for controlling microbial growth and does not exceed prescribed or guideline values under differing flow rates and water demands.

4.13 The frequency of biocide monitoring and verification, in addition to temperature monitoring, will depend on the treatment regimen selected. Each treatment system should have a failsafe mechanism to prevent overdosing while also ensuring that effective concentrations are maintained throughout

the system. When a water system is being purged and is initially dosed, checks should be made at various system outlets to ensure that satisfactory concentrations of treatment chemicals are being achieved throughout the system. Automatic leak detection of the biocidal treatment system is also recommended for hazardous substances.

4.14 The effective concentrations of biocides used to treat water systems in highly colonised systems or during commissioning of new installations in healthcare domestic water systems may initially need to exceed the safe concentrations for human consumption as stated in water legislation and may make the water unwholesome. The biocidal treatment systems used should be selected with care and must comply with the requirements of the Water Supply (Water Quality) Regulations 2000 and COSHH Regulations. Where there has been a requirement to provide biocides at concentrations above those permitted for drinking water approval, agreement should be sought from the WSG. In such circumstances the water system should be off-line and drinking-water outlets should be clearly labelled as unsuitable for ingestion (this includes the making up of neonatal feeds).

Note

When water treatment and control programmes are effectively maintained to control *Legionella*, there will be less likelihood of colonisation of other opportunistic microorganisms. However, in the case of *P. aeruginosa*, where the origin may be due to retrograde contamination from patients and/or staff, other local management control measures and monitoring will be necessary.

Chlorine dioxide

4.15 Chlorine dioxide is an oxidising biocide that is capable of reacting with a wide range of organic substances and has been shown to be effective in the control of organisms in water

systems. The safe in situ generation of chlorine dioxide as a chemical for drinking water treatment is subject to BS EN 12671. Chlorine-dioxide-generating equipment should be selected to ensure product efficacy of greater than 90% to provide the optimum performance for the minimisation of total oxidants.

4.16 The use of chlorine dioxide as a control measure will depend on the design of the systems in use and, in an existing system, its operational history. See also HSG274 Part 2.

Copper/silver ionisation

4.17 Ionisation is the term given to the continuous release, by electrolytic action, of copper and silver ions into water.

4.18 The Water Supply (Water Quality) Regulations 2000 set a standard for copper of 2 mg/L, and this must not be exceeded.

Note

Currently the Drinking Water Directive does not include a prescribed concentration for silver, as there is insufficient toxicological data. The World Health Organization (WHO) (2011) states: “there is no adequate data with which to derive a health-based guideline value for silver in drinking water”. It continues: “special situations exist where silver may be used to maintain the bacteriological quality of drinking water [and] higher concentrations of up to 0.1 mg/L ... could be tolerated in such cases without risk to health”.

4.19 Copper/silver ionisation requires soft water to prevent scaling of the electrodes, as maintaining adequate silver ion concentrations in hard water systems can be difficult because of scale build-up on the silver electrodes, potentially leading to the obstruction of copper and silver ion release. In addition, there have been cases of staining to sanitaryware in hard water areas. See also HSG274 Part 2.

Ozone and ultraviolet treatment

4.20 Whereas biocides dosed into the water are intended to be dispersive and will result in a biocide agent within the water system, ozone and ultraviolet (with appropriate pre-filtration) are intended to be effective close to the point of application. UV will only be active in waters of low turbidity and at the point where the water passes through the UV lamp housing. Ozone will only be effective very close to the point of application. Ozone and ultraviolet treatment will not ensure system control downstream in the hot and cold water service systems.

Note

Consideration needs to be given to the risk of bromate formation when using UV and ozone to further treat chlorinated mains water, which may contain bromide ions (see the [DWI's research paper](#) on the formation of bromate during drinking water disinfection).

Other water treatments

4.21 A range of biocidal treatment systems are available, and further advice on their use is given in HSG274 Part 2.

Point-of-use filtration

4.22 For pathogenic waterborne organisms including multi-drug-resistant strains, at a minimum, and in accordance with the organisation's water safety plan, a risk assessment should be made in order to determine whether sterilising-grade point-of-use filters should be installed or whether taps need to be changed (see American Standard Test Method (ASTM) F838-05 – 'Determining bacteria retention of membrane filters utilised for liquid filtration').

4.23 During design and installation, it is necessary to ensure that:

- they comply with all appropriate regulations and meet EU legislation on the preparation of foodstuffs for infants and young children;
- tap outlets have appropriate fittings for attachment of filters;
- sufficient activity space between the filter outlet and the basin is provided so that an effective backflow prevention air gap (AUK3) is maintained, and hands can be comfortably washed without contaminating the body of the filter;
- there is sufficient flow once a filter has been fitted to enable effective hand-washing;
- the filters are changed at the intervals specified by the manufacturer.

4.24 In systems with high particulates, a prefilter may be necessary to prevent shortened lifespan due to filters clogging.

5 Metal contamination

5.1 If plumbing systems were installed before 1987 (in which lead pipes or lead-based solders are likely to have been used), it may be necessary to consult the water undertaker (see also [paragraphs 3.8, 3.20 and 3.33](#)).

5.2 The Water Supply (Water Quality) Regulations 2000 and the Private Water Supplies Regulations 2009 set an upper concentration for lead in drinking water of 10 µg/L. This value is likely to be exceeded if lead pipes are present or if copper pipes have been joined with solder containing lead. If drinking water contains more than 10 µg/L of lead, remedial action should be taken. The use of lead solder is prohibited on all plumbing installations where water is required to be wholesome.

5.3 Copper concentrations above 1 mg/L may cause staining of laundry and sanitaryware and increase the corrosion of galvanised iron and steel fittings. While the maximum allowable copper concentration in drinking water is 2 mg/L, most supplies will give a concentration at the tap of less than 1 mg/L.

5.4 Water supplies to certain specialist units such as maternity, neonatal paediatric, general paediatric and renal dialysis units (see the [Renal Association guidelines](#)) should be monitored to ensure that water quality is within acceptable limits. The design team should seek toxicological advice to ascertain the exact water quality requirements for specialist units.

5.5 Where the water supply is known to dissolve metals (for example, water with very low total dissolved solids), regular sampling to determine the condition of the system

should be carried out. Strategic sampling points should be selected to ascertain that the level of metal contamination (for example, the dissolution of lead solder in capillary joints) in the water distribution does not result in limits above the stated safe levels.

5.6 Elevated concentrations of copper can occur in copper pipework systems with:

- naturally acidic (low TDS) water supplies;
- base-exchange softening;
- poor control of oxidising biocides;
- poor control of copper/silver ionisation;
- localised stagnation.

5.7 In some areas with known aggressive water issues, it is normal to specify corrosion-resistant pipework materials such as stainless steel or plastic. These materials may also need to be considered for demineralised, fully deionised and high purity water.

6 Water softening

6.1 Hard waters are unsuitable for many industrial and domestic purposes. Treatment may therefore be necessary to remove or alter the constituents to render the water suitable for particular purposes and increase the effectiveness of control measures.

6.2 Hardness is due to calcium and magnesium salts in the water and is expressed in terms of milligrams per litre as CaCO_3 . Temporary (carbonate) hardness is related to the bicarbonate salts of calcium and magnesium. Permanent (non-carbonate) hardness is related to the other salts of calcium and magnesium – chlorides, sulphates, nitrates etc. The generally accepted classification of waters is shown in Table 1.

Table 1 Classification of water hardness

Description	Milligrams per litre (mg/L as CaCO_3)
Soft	0 to 50
Moderately soft	50 to 100
Slightly hard	100 to 150
Moderately hard	150 to 200
Hard	200 to 300
Very hard	Over 300

6.3 When the temperature of water is raised, the hardness will be reduced by some of the bicarbonate dissolved salts (temporary hardness) coming out of solution and forming solids in suspension, some of which will be deposited on heating surfaces to form an adherent limescale, thus reducing the heat-transfer rate. The tendency to form scale, and the morphology of that scale, is not just dependent on the hardness but also on the other chemical constituents of the water. For this reason scaling indexes such as Ryznar and

Langelier combine various additional factors to assess the likelihood of scaling.

Note

Primary heating circuits that are filled/topped up by water supplied directly from the water mains should be treated with a chemical corrosion inhibitor. Specialist advice is given in BSRIA's BG50 – 'Water treatment for closed systems'. In exceptionally hard water areas, additional measures may be required.

6.4 The extent of treatment required to prevent scale formation will depend on the process for which the water is being heated; it may therefore be necessary to achieve one of the following conditions:

- a. replacement of calcium and magnesium salts by their more soluble sodium equivalents;
- b. removal of all salts (demineralisation);
- c. where water of enhanced purity is required for specialised uses, it can be produced from softened water by reverse osmosis or by demineralisation.

6.5 The most common water-softening process used for the protection of hot water calorifiers is base-exchange softening. This process 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 sodium ions.

Note

All water softeners must be installed with an appropriate backflow prevention device in accordance with the Water Supply (Water Fittings) Regulations 1999. Where softeners discharge to a drain, they must have an appropriate air break to the drain installed such as a type AA or an air-break-to-drain device in accordance with BS EN 1717 clause 9.

6.6 Epidemiological studies have shown that the incidence of cardiovascular disease tends to be higher in areas with soft water supplies than in areas with hard water supplies. The association is clearest where the soft water supplies contain hardness below about 150 mg/L (as CaCO₃). The explanation is not known, but it is considered prudent, where possible, not to drink water that has been artificially softened to concentrations lower than this. Softened water may also tend to dissolve metals from pipes. Water softeners containing ion-exchange resins may be subject to bacterial contamination if not adequately maintained in accordance with the manufacturer's instructions (these may also require periodic disinfection). Softeners using salt-regenerated ion-exchange resins increase the sodium content of the water during softening, and this may be undesirable for young children and infants (including the making up of babies' bottles) and anyone on strict salt-restricted diets. These concerns can be avoided if water intended for drinking and cooking is not softened. See also [paragraph 9.11](#).

6.7 Waters having a hardness of up to 400 mg/L have been used for public supplies without preliminary softening. While it is accepted that supplies for domestic purposes need not be softened, some water undertakers carry out partial softening.

6.8 The need for softened water in healthcare facilities for domestic purposes other than drinking and cooking should be considered on the merits of each case; if treatment is considered essential, the extent of softening should be the minimum to achieve an

acceptable level. A generally acceptable range is between 80 and 150 mg/L, and not less than 60 mg/L, but this should not be taken as a requirement for healthcare facilities as it may be impracticable to achieve. The cost and difficulties of treatment may be prohibitive for certain waters if the hardness value is particularly high and the content of magnesium is appreciable.

6.9 Scale deposition is a significant problem in pipework, reducing flow, efficiency and increasing the surface area for biofilm formation. In hard water areas, softening may well be needed to reduce risk. Generally, within healthcare premises, softening of a hard water supply may be required on feeds to the following:

- a. steam boilers – to prevent sludge and limescale building up (see BS 2486);
- b. hot water services where outlets (particularly showers) are affected by limescale;
- c. laundries – high maintenance costs and the uneconomic uses of soap or detergents are caused by the presence of hardness.

6.10 Other water-softening methods include physical water conditioning and magnetic water conditioning.

7 Filtration

7.1 Water delivered to premises may have been derived from various river and groundwater sources, the quality of which can be different, thus requiring a number of treatment processes. Filtration to an appropriate standard will normally have been carried out by the water undertaker or private water supply operator. Some treatment works use additional methods to remove minute and fine suspended particles from water. These include microfiltration, ozone, carbon and ion-exchange systems.

7.2 In exceptional circumstances or where a private water supply is used on site, additional on-site filtration may be required as part of a multi-barrier point-of-entry treatment system. Advice should be sought from the appropriate undertaker on the need and form of such treatment. For a list of approved products for private water supplies, visit the [DWI's website](#).

Note

POU filtration is covered elsewhere in this publication.

8 Water storage

Note

Refer also to HSG274 Part 2.

8.1 Water is stored in healthcare premises for the following reasons:

- a. to provide backflow protection;
- b. to provide a reserve supply during disruption of the incoming cold water supply (this encompasses water quality as well as water quantity issues);
- c. to reduce the maximum demand on the cold water supply;
- d. to reduce the pressure from that of the distribution system.

Note

Separate arrangements are required to provide accommodation for the expansion of any water subjected to heat, that is, hot water and heating services.

8.2 The purpose for which the storage is used can vary, but has only a minor effect on its design. The following generally covers a typical range of uses:

- a. cold water services, domestic, laundry etc;
- b. cold water feed to hot water services;
- c. pathology;
- d. endoscopy units;
- e. dental premises;

- f. treated cold water for laundries, heating etc when local supplies are unsuitable;
- g. break-tanks on cold water supplies serving points of use where backflow is, or is likely to be, harmful to health due to a substance representing a serious hazard (for example, supplies to pathology laboratories (see [paragraphs 12.18–12.24](#) on the prevention of contamination));
- h. fire-fighting.

Note

Feed and expansion cisterns for heating services, chilled water etc are excluded.

8.3 All water storage for domestic purposes should meet drinking-water quality requirements.

Note

Separate drinking water systems are not recommended for new buildings.

Water supplies

8.4 Where there is private supply in addition to the water undertaker's, it needs to be introduced separately into the healthcare facility's water storage system. See [paragraphs 2.3–2.4](#) (connection arrangements and notification requirements) and [12.18–12.24](#) (backflow prevention requirements) for compliance with the Water Supply (Water Fittings) Regulations 1999.

Note

It is best practice to include the operation of valves in a regular maintenance and operation schedule to ensure they do not become seized. The flushing of the supply could be integrated into this programme to aid the prevention of stagnation of water at dead-ends. Additionally, advice from the water undertaker on an appropriate time period to undertake flushing cycles on supplies should be sought.

Extent of storage

8.5 Storage should be designed to minimise residence time in the cistern and maximise turnover of water to avoid stagnation and deterioration of water quality. Storage volume should be calculated on the basis of peak demand and the rate of make-up from source of supply. There may be more than one peak period during each day. The interval between peak periods is important as it affects the storage capacity based on the make-up flow. It also determines the available time for maintenance if twin cisterns are not installed. Unless the water supply is particularly vulnerable to disruption and subject to risk assessment (balancing the microbiological risk and contingency supplies), a nominal 12 hours' on-site storage is recommended. Reference should also be made to paragraphs 5.18–5.34 in HBN 00-07 – 'Planning for a resilient healthcare estate', which provides guidance on continuous water supplies and bulk storage.

8.6 There is currently no reliable guidance on the capacity of water storage. Design teams should therefore liaise with the commissioning trust to ascertain their recent records the quantity of water used over the previous five years. There is evidence that the historical values given for district general teaching hospitals that amounted to 900 L per day per bed are in excess of actual usage. If the proposed healthcare building development includes significant changes in function that introduce greater specialisms and more intensive treatment programmes, then the

design team is advised to seek guidance from other healthcare organisations that are responsible for buildings of a similar nature.

Note

Useful data may be derived from the following:

- Water figures per unit of healthcare activity are published by the NHS Sustainable Development Unit. See [Appendix 1](#).
- The [Estates Returns Information Collection](#) (ERIC) collects data from all NHS trusts on the consumption and associated costs of water.

8.7 The design team should ensure that the local water supplier is involved in proposals for planning the water storage values. CIBSE's Guide G – 'Public health engineering' gives further guidance on sizing cold water storage.

8.8 A summation of the average daily consumption for each ward unit contained in a building should be made. From the requirements of each building, the policy of water storage for the whole complex should be decided. It does not always follow that peak demands for each building will coincide, and therefore there may be scope for applying a diversity factor to the whole site.

8.9 Where the water requirement is to be met from a private supply, the summation for each building may require assessment on the basis of storing and using water according to the minimum treatment of the water for each particular use. Likewise, where the water is hard enough to require softening for certain domestic and/or laundry purposes, separate storage will be required, and this should be taken into account when assessing the total stored water.

8.10 Staff quarters and industrial areas may be remote from the main building and supporting departments. The laundry may serve a number of healthcare buildings as well as the premises

at which it is located. The storage requirement for such accommodation should therefore be calculated separately and integrated with the accommodation whenever this is practical.

8.11 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 (but not tank storage) to be allocated. It is important that, where it is anticipated that a building will be occupied in phases, the storage levels can be raised as required. Commissioning should be carried out also as a planned process related to occupation following a risk assessment (see BS 8550). The design should facilitate compartmentalisation.

Location and form of storage

8.12 The location of storage will depend on the total volume required, the topography and layout of the site proposed for development, and the sources and adequacy of the water supply. A limited site footprint may call for much higher buildings to achieve the required accommodation. Depending on the supply water pressure, it may be necessary to install pressurisation equipment to boost the incoming supply. The cost of the supporting structure will have an important bearing on the solution adopted.

8.13 Where storage is located in individual buildings and an adequate supply is available from the water undertaker, a connection in accordance with the Water Supply (Water Fittings) Regulations 1999 to each point of storage may be the most economical arrangement. In such cases, interconnections between selected points of storage should be provided to deal with emergency and maintenance requirements, always providing that such interconnections do not contravene the Water Supply (Water Fittings) Regulations 1999 and do not result in water stagnating within the storage or distribution system.

8.14 Cisterns should not be located where there is any likelihood of flooding, excessive heat gain or any other factor that could affect the contents of the cisterns. They should not be installed in any location where access for general inspection or maintenance is restricted. Where refurbishment is undertaken, an assessment is carried out to ensure no adverse impacts occur on the temperature and quality of the water stored. As part of this assessment, climate change mitigation measures should be considered.

8.15 Separate systems are required to segregate domestic services (WC, hand-washing etc) from high-risk applications and equipment within such facilities as laboratory, pathology and mortuary departments.

8.16 An assessment of atmospheric and environmental (including feral wildlife such as birds etc) risks should be undertaken to ensure they do not affect the temperature or quality of stored water. If concrete water cisterns are to be considered, they should be designed to form an integral part of the building structure. The materials of construction, however, must comply with the Water Supply (Water Fittings) Regulations 1999.

8.17 As in the case of external storage, cisterns should be installed in positions where they can be readily inspected and maintained and where they will not be affected by frost or high temperatures.

8.18 To determine access requirements to cisterns, it is essential that a suitable and sufficiently comprehensive assessment of the risks for all work associated with cisterns is carried out to determine what measures and parameters are required under Regulation 3 of the Management of Health and Safety at Work Regulations 1999. For work in confined spaces this means identifying the hazards present, assessing the risks and determining what precautions to take.

8.19 Roof spaces in which cisterns are to be installed should have adequate trap doors or

other means of access and adequate lighting to facilitate inspection and maintenance.

8.20 Where storage is in ground, as distinct from being housed within a building, it is essential to ensure that there is no risk of contamination. Investigations of such risk require careful consideration of site conditions and should include such aspects as:

- flooding;
- subsidence;
- the location of sewers and drains and other buried services;
- the maximum and minimum height of the water table in the area;
- the natural drainage of surface water;
- ingress of contaminants such as dust, debris etc; and
- in the event of storage below a car-parking area or roads, the danger of oil/fuel seepage.

The future development of the healthcare building and probable extensions should also be taken into account in this respect. Accessibility should be limited to those who need access (see also NHS Protect's (2012) 'Guidance on the security and management of NHS assets').

8.21 Storage below ground should be adopted only as a last resort, and cisterns should be installed within a watertight bund allowing sufficient space all around and beneath the storage vessel to permit inspection and maintenance. Any underground construction arrangement, concrete or otherwise, not directly against earth will reduce the risk of contamination. The tank chamber should include provision for a sump to collect drainage water and any piping necessary to pump out tanks to the site drainage. The Water Supply (Water Fittings) Regulations 1999 require any buried concrete reservoir to be designed, constructed and tested in accordance with BS EN 1992-3.

Note

Refer also to the HSE's [guidance on confined spaces](#).

Construction of cisterns

8.22 All storage cisterns:

- should be constructed in accordance with manufacturers' recommendations and should comply with the Water Supply (Water Fittings) Regulations 1999;
- should have been assessed and shown they are appropriate (for example, suitable approvals) for the intended purpose (see also [paragraph 1.15](#)); and
- should comply with BS EN 805, BS EN 806 (Part 1 to 5) and BS 8558. Glass-reinforced plastic (GRP) cisterns should comply with BS EN 13280.

8.23 The WRAS Information and Guidance Note 9-04-04 – 'Cold water storage systems – design recommendation for mains supply inlets' provides useful advice regarding the design of the inlet arrangements to ensure compliance with the Water Supply (Water Fittings) Regulations 1999. Of particular importance is the need to ensure cistern roof supports are of a type that do not retain water within the support, cause pockets of stagnation, or prevent the free flow of water throughout the cistern, as these have been shown to cause degradation of the stored water quality (see also Estates and Facilities Alert EFA/2013/004 – 'Cold water storage tanks'). Any other internal structures should be designed so as not to retain water, cause pockets of stagnation, or prevent the free flow of water throughout the cistern.

8.24 Depending on size and/or capacity, water storage should be divided into convenient compartments suitably interconnected and valved to facilitate cleaning, disinfection, repair, modification and inspection, without seriously disturbing the cold water service. Cistern strengthening should be by means of

stainless steel tie bars and not baffle plates. Where multiple cisterns are provided, they should be connected in such a way that there is equal flow to prevent stagnation. Pipework connections should also be arranged to ensure cross-flow across the cistern. A water meter should be considered at each inlet pipe to verify equal volumes are being used.

8.25 Separate cisterns should also be provided for storage of different water supplies, for example central-heating header cisterns, cold water storage, softened water, fire-fighting water, and high-risk areas (for example, laboratories, pathology and mortuary). Precautions should be taken to ensure that mixing does not take place between such supplies, and it should be noted that isolation by means of shut-off valves between them is not acceptable.

8.26 The materials used for storage cisterns serving healthcare should be appropriate for the intended use. The material selected should comply fully with the Water Supply (Water Fittings) Regulations 1999 (see [paragraph 1.15](#)). Pre-insulated sections are recommended where practicable.

8.27 Sectional cisterns fabricated from GRP or pressed steel provide a convenient means of bulk storage of water at atmospheric pressure. The components can be readily transported to site and, subject to unit multiples, they can be erected to give varying proportions of length to breadth and depth. It is also possible to make provision for future extension in capacity by an increase in available base area or, within limits, depth. If sectional cisterns are selected, designs with external assembly flanges and self-draining profiles should be used, since this arrangement facilitates easy cleaning of internal surfaces of the cisterns.

8.28 The Water Supply (Water Fittings) Regulations 1999 laid down the minimum requirements for wholesome water storage cisterns. Recommendations to comply with these are given in the WRAS 'Water Regulations Guide'. The requirements are indicated in [Figure 2](#).

Note

Cisterns should be sited away from heat sources and be protected from heat gains by insulation. Adequate and safe access should be provided for inspection and maintenance (both internally and externally).

8.29 Each storage cistern or its compartment should also be provided with the following:

- a. internal and external access ladders as necessary to comply with current health and safety requirements;
- b. a full-way servicing valve at each inlet and outlet connection, except for cisterns providing water to primary circuits or heating circuits, overflow pipes, and warning pipes. Where practicable, all outlets should be taken from the base of the system and be sited opposite to the inlet;
- c. a suitably-sized drain connection complete with isolating valve. The invert of the drain connection should be positioned so as to provide maximum drainage of the cistern.

8.30 Cisterns in roof spaces should be adequately supported on bearers placed under the longitudinal or lateral cistern section joints. To avoid distortion, a flat section of marine ply or equivalent should be sited between the support structure and the cistern. Final siting should be in accordance with the manufacturers' recommendations. See also the Note after paragraph 8.28.

8.31 The design may incorporate a watertight drip tray under the cistern to contain condensed water or leakage so as to avoid damage to accommodation below. The necessity of a drip tray or watertight bund with drainage will depend on individual case requirements. The floor of the drip tray or bund should be graded to a drainage sump complete with drain pipe. A single pipe should drain off any overflow water from the sump and lead to a discharge point at ground level where any water flow would be readily noticed.

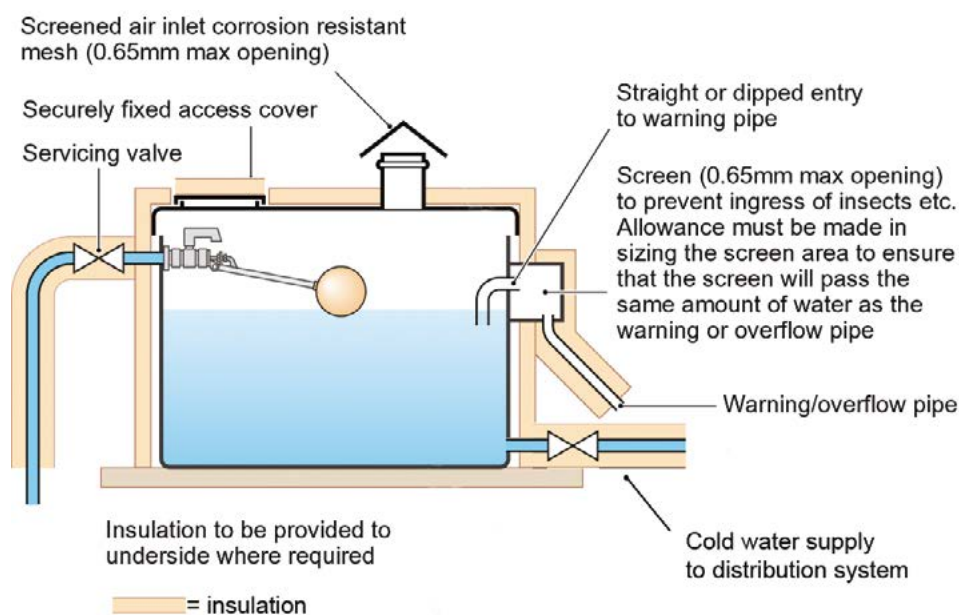


Figure 2 General wholesome water storage cistern arrangements

If it is not possible to terminate the discharge pipe from the sump so that any discharge of water can be seen, an audible alarm should be installed to warn of overflow conditions. Cistern support levels should be constructed to keep the valves clear of the water level in the drip tray or bund in the event of cistern leakage. Special requirements apply to the supporting of GRP sectional cisterns on bearers, and manufacturers' recommendations should be observed. The cistern should be provided with a warning pipe or a no less effective device to indicate leakage through the inlet control valve if this should occur.

8.32 On no account should a sectional cistern be installed on a concrete plinth (directly or on steel beams) that is protected by an asphalt membrane. Subsequent irregular settlement into the asphalt may lead to cistern distortion and leakage.

8.33 A consideration in deciding cistern shape and layout is the location of the services duct. Whereas the cistern room may be positioned aesthetically in relation to the building elevation, the duct serving it will be located to suit the internal layout. The pipe route from the system to the service duct will require access for inspection and protection from frost and heat gain.

8.34 Typical piping and valve arrangements for dual-cistern installations are shown in [Figure 3](#). Supply and draw-off connections should be arranged to facilitate good through-flow and turnover of stored water without stagnation. Advice on interconnection is given in the WRAS leaflet "[Interlinked cold water storage cisterns](#)".

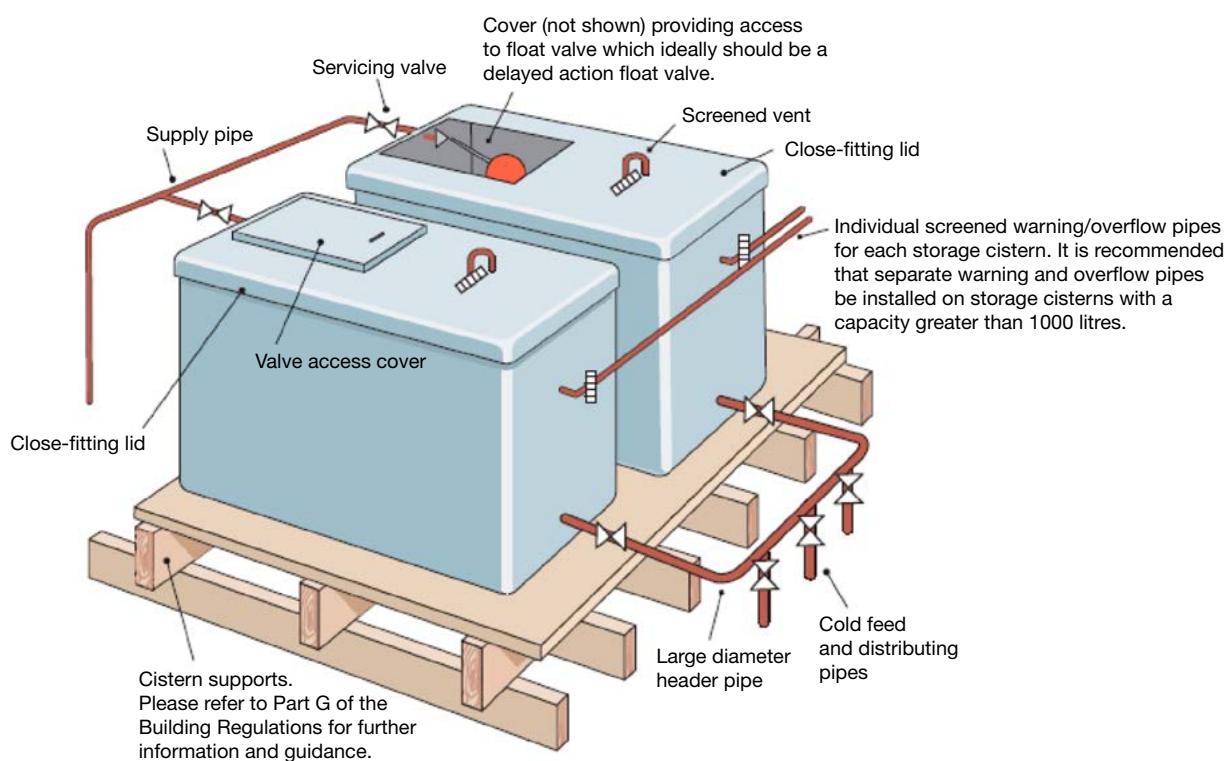
8.35 General space lighting should be provided in cistern rooms together with suitable power points for low voltage small tools and inspection lamps.

8.36 The contents and capacity of all cisterns should be clearly labelled as per the Water Supply (Water Fittings) Regulations 1999. The operational water level should be indicated.

Ancillary pipework, valves and fittings

8.37 The arrangement of the cisterns in the room should be such that the pipework runs are as short as possible, but accessibility and walkway clearances are ensured. Flanges on parallel runs should be staggered.

8.38 All cistern-room pipework and valves should be insulated and clearly labelled to identify their purpose.



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Figure 3 Piping and valve arrangements for dual-cistern installations

8.39 The use of delayed-action float-operated valves on water storage cisterns should be considered, since these help avoid stagnation of water in the cistern. They may not be suitable when the supply is pumped.

8.40 Strainers should be fitted within the water pipework system if not supplied integral to the valves, and are used to protect vulnerable valves and fittings against ingress of particulate matter. The installation of these fittings should allow adequate access for maintenance/replacement, and they should be provided with means of upstream and downstream isolation as appropriate. Strainers can be a source of *Legionella* bacteria and should be included in routine cleaning, maintenance and disinfection procedures (see Chapter 7, Part B).

8.41 Service isolation valves should be fitted to all pipework preceding sanitary tapware, WCs etc for servicing, repair or replacement. Drain-valve provision may also be appropriate for certain installations, for example, service

pipework to en-suite facilities. Suitable backflow prevention devices or arrangements should be provided appropriate to the fluid risk category (see the Water Supply (Water Fittings) Regulations 1999).

Expansion vessels

Further advice can be found on the [WRAS website](#).

8.42 Expansion vessels (see Figure 4) are typically vertical in orientation and have a bladder or diaphragm either with nitrogen or with air fill in the upper space. They introduce a potential problem of microbial colonisation, including *Legionella*, as plantroom temperatures usually exceed that of the incoming water.

8.43 Such vessels should be appropriately sized, installed and operated in a manner that prevents the accumulation of debris, pockets of stagnating water and increases in temperature

within the vessels. They should preferably be of a design in which water passes through the vessel entering at low level and exiting at high level. (For smaller vessels it may be appropriate to utilise specialist valves which promote the flow of water within the vessels or allow sufficient pressure movement so that water is changed over during normal operation.) When larger vessels are installed, adequate flushing and drain-down connections should be provided at the top and bottom of flow-through vessels or at the bottom only of diaphragm or bladder types.

8.44 All materials in contact with water should have been assessed and shown they are appropriate (for example, suitable approvals) for the intended purpose (see paragraph 1.15). It is important that the expansion vessel is located on the cold feed rather than on the hot water side of the system.

8.45 Interconnecting pipework should be kept to a minimum, and the vessel should be sited and insulated to minimise heat gain. Where diaphragm or bladder-type vessels are used, they should be designed to ensure an adequate turnover of water within the vessel.

Note

Vessels where the diaphragm or bladder is designed to be replaceable may be considered as they will facilitate routine checking and/or replacement when contaminated.

Water meters

8.46 BS EN 806-2 Section 11 gives guidance on the design and installation of water meters.

8.47 Revenue meters are normally supplied and installed by the water undertaker to their specification, whereas the consumer may install sub-meters within their system.

8.48 Adequate sub-metering of water supplies should be provided so that supplies can be monitored for individual heavy-use departments. Such monitoring will assist in the detection of leaks or abnormal water demands. Water meters can be connected to an automatic monitoring system such as a BMS, which can identify anomalous consumption and lead to the early detection of leaks.

There are several types of vessel available including diaphragm or bladder type, with fixed and interchangeable (replaceable) bladders, as shown below. These internal bladders are often made of synthetic rubber such as EPDM and may support the growth of microorganisms including *Legionella*, so check to see if these are approved against BS 6920. Vessels with a 'flow through' design should provide less opportunity for water to stagnate and become contaminated (as in the latter design).

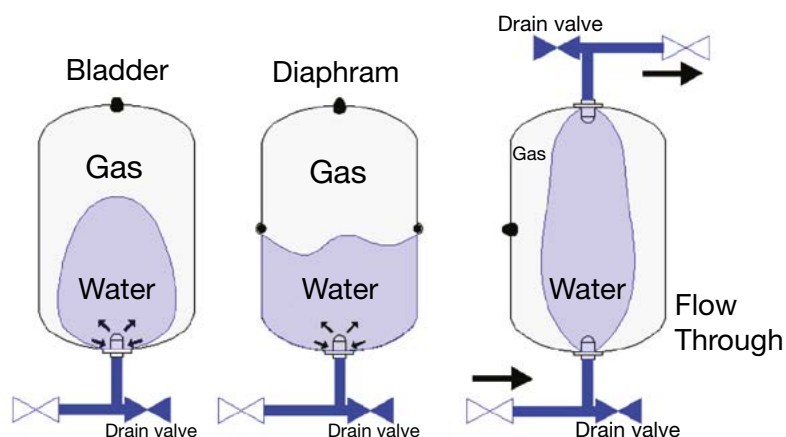


Figure 4 Expansion vessels

8.49 Only where downstream applications are considered critical and in need of a continuous supply of water should bypass arrangements be considered for consumer sub-meters. Where this is the case, sub-meters should have an upstream and downstream isolation valve. In case of servicing or replacement of the water meter, a replacement pipework insert should be stored in clean sterile conditions adjacent to the meter.

8.50 Meters should also be considered on the cold supplies to cisterns and hot water storage vessels where multiple units are installed supplying the same system. This will allow equal usage and turnover to be verified.

9 Cold water distribution system

9.1 The design and installation of the cold water distribution system should comply with the Water Supply (Water Fittings) Regulations 1999 and relevant parts of BS EN 806-2 and BS 8558. A simple cold (and hot) water system is shown in [Figure 5](#).

Note:

All pipework should be insulated. All drains should discharge to waste via an appropriate air break to the drain such as a type AA air gap or an air-break-to-drain device in accordance with BS EN 1717 clause 9.

9.2 Cold water pipework runs should be designed and installed to reduce the risk of heat gain and should not be above or near heat sources including ceiling-mounted radiant heating panels. Cold water service mains should be run within a different ceiling space, riser or zone from other heat sources. This includes the hot water service distribution system and steam supply. If not possible, the cold water service and hot water services should be run apart as far as practicable and preferably with the hot water at a higher level than the cold.

9.3 All pipework and valves should be insulated, except for any exposed final connections to sanitary appliances. Insulation should be of an optimum performance (relating to thermal values and thickness) to minimise heat gains in order to achieve the temperature regime. The installation of insulated pipe supports and a vapour seal is recommended for all areas susceptible to heat gain and/or condensation. All insulation should be installed

in accordance with BS 5970. All pipework should be arranged to eliminate or minimise dead-legs. Additional guidance can be found in BS 8558 Tables 6 and 7.

9.4 Currently there is no upper limit standard for drinking water temperature in European or domestic legislation. In normal circumstances temperatures should be delivered below 20°C but there is growing evidence that supply temperatures may rise above 25°C in summer months. Coupled with improvements in building thermal performance and climate change, rising cold water supply temperature is likely to become more problematical. The design aim should be to ensure that cold water temperature draw-off is as close to the supply temperature as possible (see also paragraphs 2.55–2.56 from HSG274 Part 2).

9.5 Government guidance to the Water Supply (Water Fittings) Regulations recommends that as far as is reasonably practical cold water temperatures should not exceed 20°C. As far as possible, the objective should be to design the cold water systems to ensure that the inlet, outlet and surface water temperatures of cisterns and cold water feed/header tanks for the hot water calorifiers are not greater than 2°C above that measured of the incoming water supply at the property boundary. Also, at cold water draw-off points, a temperature of no greater than 2°C above the temperature measured in cistern and cold water header tanks should be reached within two minutes (see also [paragraph 11.1](#)).

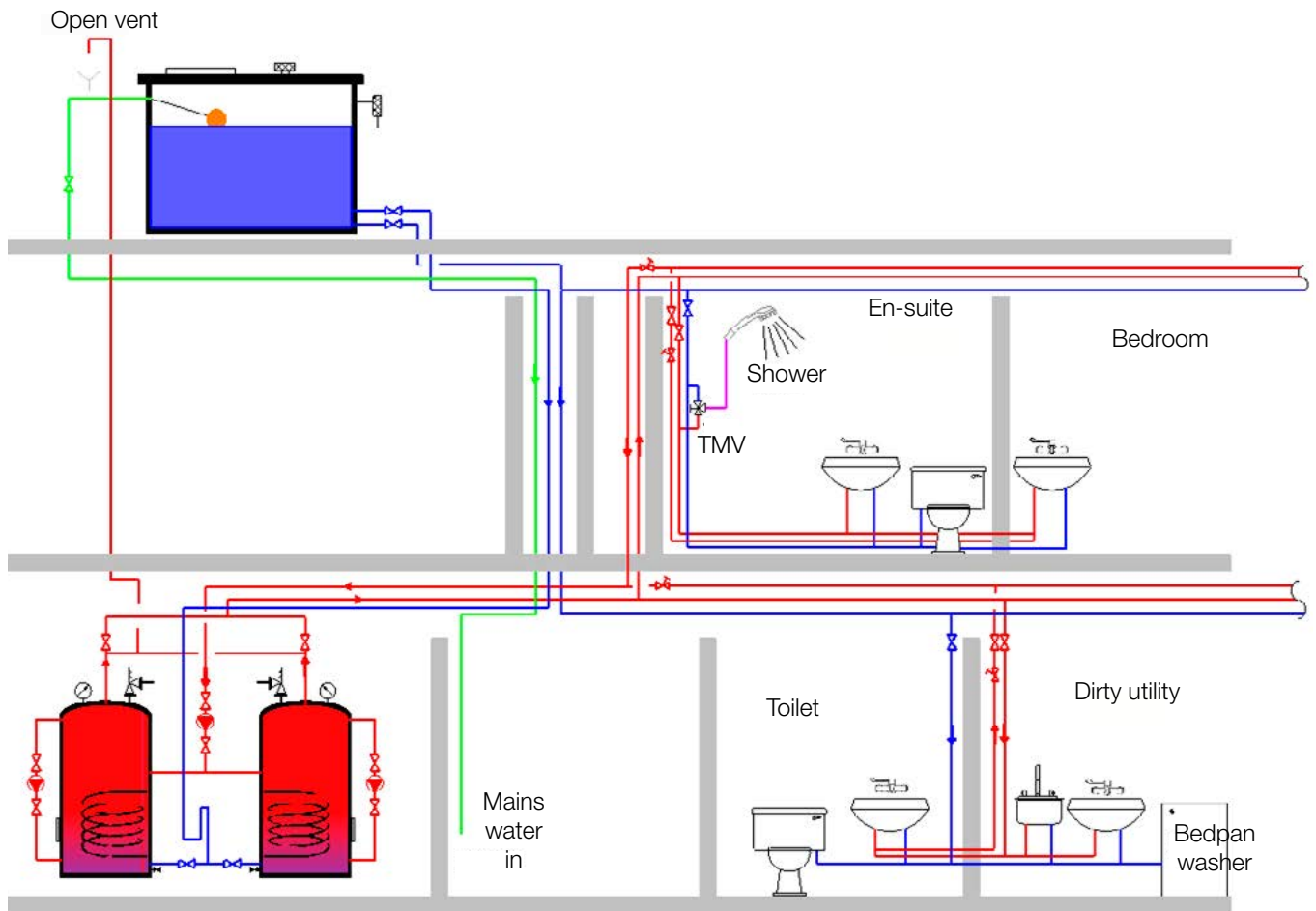


Figure 5 Schematic layout of a cold (and hot) water service system (note: this is a schematic only, and therefore all isolation valves and specific pipework configuration recommendations may not be included)

Note

For the control of *Legionella* and other waterborne organisms, 20°C is the quoted upper value above which multiplication of *Legionella* in particular begins to take place (see Part B, Chapter 4). It should be noted that during extremes of weather, environmental factors can influence the incoming water temperatures, particularly where water is provided from surface water sources.

9.6 Historical data should be sought on incoming cold water temperatures, especially during the summer and autumn, to allow these factors to be built into the design of the cold water system. If temperatures exceed 20°C, then further control measures should be implemented based on the risk assessment.

9.7 The control of water temperature in the cold water service, however, will essentially rely on good insulation and water turnover. Cold water services should be sized to provide sufficient flow at draw-off points and prevent stagnation.

9.8 Further cooling of cold water should only be considered in specialist units where people are at particular risk as a result of immunological deficiency, for example bone marrow transplant units. For other accommodation, the aim should be to promote turnover of cold water by means of the design of the distribution circuitry.

Note

Cooling water that may have been previously at a temperature conducive to *Legionella* growth will not reduce the risk of infection.

9.9 In all areas (particularly those with en-suite facilities), the aim should be to supply sanitary assemblies in series, with the WC connected as the final element to promote regular throughput of cold water. Elsewhere, pipeline routings should be run so that other outlets are connected in such a way that a WC or flushing device (for example, sluice hopper or pantry sink) provides the final element at the distal end of the branch – this may require pipe routing reversal (see [Figure 6](#)).

9.10 The cold water distribution system should be designed so that the pressure is the same as that for the hot water service at draw-off points. This may require the inclusion of pressure-reducing valves in the distribution pipework. If unequal pressures exist in the hot and cold water supplies to combination taps where water mixes in the body of the tap, a single check valve is required on each feed pipe to the tap to prevent backflow of water from one to the other.

Note

See also [paragraph 10.53](#) on the fitting of in-line strainers.

Drinking water

9.11 When separate drinking-water systems have been provided, the policy has normally been to distribute directly from the mains without storage (nor softening), with stored cold water (down service) being used solely for supplies to WCs, wash-hand basins etc. Providing drinking water without storage may not be appropriate in healthcare premises because of the need to have some security of supply. The advantage of separate drinking and cold water services chiefly lies in the possibility of treating the latter (softening or other forms of treatment) without adulterating the drinking, cooking and food

preparation supplies. The WSG should define a strategy either for separate supplies or for restricting the extent of softening (see also [Chapter 6](#) on water softening).

9.12 Low water flow is often experienced in dedicated drinking water systems leading to stagnation, and the likelihood of temperatures exceeding 20°C. The preferred option may be to decommission dedicated drinking water systems totally. A risk assessment should show the optimum solution for patient safety.

9.13 A possible strategy, therefore, is to have a drinking water system that also provides WC flushing and, to some extent, this will assist water turnover and the maintenance of water quality. The disadvantage of the concept, apart from installation cost, is that the use of WCs, particularly in en-suite facilities, as the mechanism for achieving good utilisation in the cold water service no longer becomes possible (see paragraph 9.9). The concept for water turnover in en-suite facilities could still be achieved, however, if the cold water service were run in series to en-suite facilities with minimum dead-legs to draw-offs, with the final connection on the system being a highly utilised outlet, for example a sink. Automatic flushing WCs should be considered to assist with maintaining water turnover in cold water systems.

Note

Sensor-activated delivery devices that have a duty cycle feature to prevent stagnation should be considered. This feature should be activated only where required. Note that automatic flushing devices should not be located in accommodation used by patients who may become distressed by the noise.

Pumped systems

9.14 Where the pressure of the water undertaker's supply is inadequate, it will be necessary to use pressurisation plant. Similarly, pumping or pressurisation may be required for fire-fighting purposes.

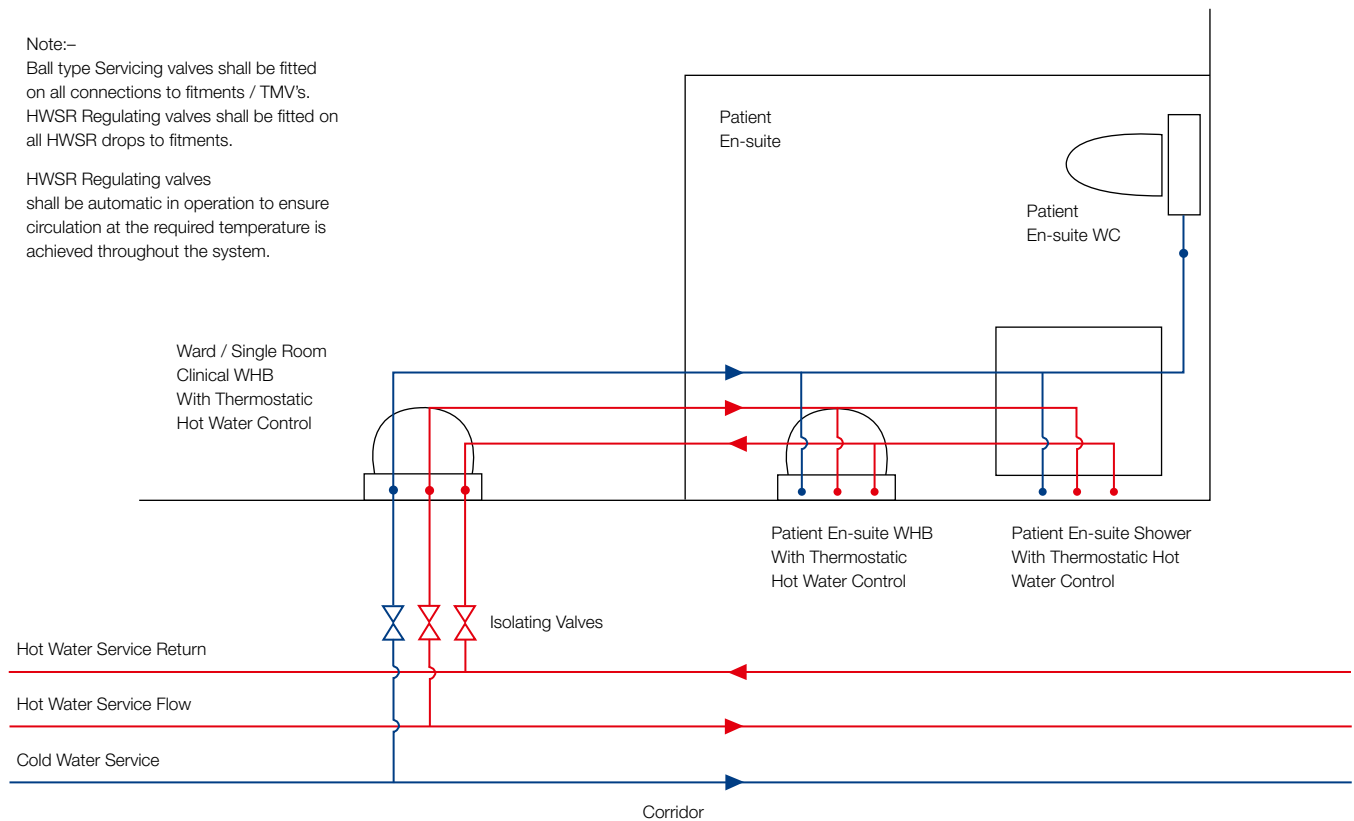


Figure 6 Piping arrangements for an en-suite facility

9.15 Various arrangements of pumping system are indicated in BS EN 806-1 Part 5 and BS 8558. Where booster pumps are to be installed, a break cistern will be required between the mains supply pipe and the pumps. This is required to comply with the Water Supply (Water Fittings) Regulations 1999 with regard to prevention of backflow. Any pump delivering more than 12 L/min must be notified to the water undertaker whose consent is required.

9.16 Control of the pump(s) should be fully automatic in operation and controlled by pressure sensors for the following reasons:

- a. to reduce energy consumption;
 - b. to prevent heat gain from the pump to the water, which could become significant if large pumps are used;
 - c. to reduce wear on the pumps and hence reduce maintenance.
- a. quantity and pressure of water to be pumped;
 - b. the number of units required to obtain the necessary output and to provide adequate standby capacity;
 - c. the desirability of speed variation;
 - d. the degree of automatic sequence control required (but with manual override);
 - e. the characteristics of the system on both the delivery and suction sides, and in pumping efficiency and priming requirements;
 - f. the type of materials used in manufacturing the pumps relative to the chemical analysis of the water to be pumped;
 - g. ferrous materials should not be incorporated into wetted surfaces.

9.17 Factors to be considered when selecting pumps are:

9.18 Depending on the circumstances, the operation and shutdown of pumps may be controlled by various methods (for example,

water-level float switches, pressure switches, flow switches, electrode probes or pneumatic systems). Certain services may also require the pumping equipment to be energised from the emergency electrical service as recommended in HTM 06-01 – ‘Electrical services supply and distribution’.

9.19 Where two or more pumps are installed, automatic control should be provided to prevent stagnation. The design should ensure that appropriate resilience is considered.

9.20 The pumping sets for lifting to higher-level storage should be controlled from the level in the high-level tanks by transmitting sensors, level switches or other suitable devices. A low-level alarm should be arranged to give a warning when the storage volume of water falls to a predetermined low level.

9.21 The plantroom should be constructed with a waterproof and non-dusting floor, and non-dusting walls and ceiling. The floor should be constructed with a slight fall to a drainage trench that should terminate in a trapped gully. The trapped gully should incorporate provisions to either avoid or replenish any trap-water-seal loss. The plantroom will require adequate lighting, ventilation and heating (to prevent freezing or condensation), with electric power points and/or provision for low-voltage supplies for portable lighting and tools.

9.22 If heavy plant is to be installed that may need to be removed for testing, maintenance or replacement, fixed lifting beams of suitable capacity should be provided.

Specialist systems

9.23 Where water supplies are required for specialist systems such as endoscope cleaning installations, dialysis units etc (see also HBN 07-01 – ‘Satellite dialysis unit’), the design team should consult the infection prevention and control team and equipment manufacturer to establish any specific water treatment requirements for the process. Additionally such systems also require backflow prevention arrangements to protect the source water

supplies from contamination. The local water undertaker should be consulted:

- to clarify the backflow prevention arrangements or devices; and
- on any possible variation in the quality of its water supply or possible changes to the source of the supply.

Vending, chilled water and ice-making machines

Note

These should not be installed in augmented care areas.

9.24 The design, installation, location and risk assessment of all equipment should be approved by the WSG (see also HBN 00-09 – ‘Infection control in the built environment’). The risk assessment should consider:

- carbon filtration in these devices, which are a high nutrient source for bacteria;
- cleanability and maintenance of the machine.

9.25 The water supply to this equipment should be taken from a wholesome supply via a double-check valve to prevent backflow and be upstream of a regularly used outlet with the minimum of intervening pipe-run, that is, less than 3 m. The supply should not be softened. Additionally, it should be established that the usage is sufficient to avoid deterioration in water quality, for example that the inlet water temperature does not exceed 20°C. The equipment should be positioned so that the warm air exhaust does not impinge directly on taps or hoses supplying cold water and to provide access for maintenance.

9.26 Design considerations include for example:

- no drinking fountain or vending machine should be installed at the end of the line (potential dead-leg);

- the pipework should be as short as possible from take-off point (mains water tee);
- the cold water supply pipework should be copper and fitted with a local isolation valve and drain valve;
- the flexible pipe connector should be kept as short as possible (see paragraphs 3.39–3.41).

Note

Flexible EPDM should not be used (see Estates and Facilities Alert DH (2010) 03 – ‘Flexible water supply hoses’).

9.27 Reference should also be made to the Food Safety (Temperature Control) Regulations 1995 and Food Safety (General Food Hygiene) Regulations 1995. The Automatic Vending Association of Britain (AV) [‘Guide to good hygiene practice in the vending industry’](#) should be followed regarding hygiene and water quality and hygienic operation of vending machines.

Vending machines dispensing carbonated drinks require special materials of construction which should have been assessed and shown to be appropriate (for example, suitable approvals) for the intended application (see also paragraph 1.15).

Other water uses

9.28 The guidance contained in this HTM is principally concerned with hot and cold water services used for domestic purposes within the interior of the healthcare premises.

9.29 This will include vending equipment, as above, and additional devices such as dishwashers and non-industrial clothes washing machines.

9.30 The cold water distribution system may also be used for non-domestic purposes outside the building but within the curtilage of the healthcare premises. This use may introduce potential hazards and reference should be made to HTM 04-01 Part B, Chapter 8.

10 Hot water services

10.1 Hot water services should be designed and installed in accordance with the Water Supply (Water Fittings) Regulations 1999 and relevant parts of BS EN 805, BS EN 806 (Parts 1–5) and BS 8558. The hot water system may be of either the vented or the unvented type.

10.2 The basic components of a hot and cold service system as used within healthcare facilities are shown in [Figure 5](#); most installations will have additional features and components.

10.3 A vented system usually consists of a cold water storage cistern situated above the highest outlets, which feeds a hot water storage vessel (for example a calorifier or direct-fired boiler).

10.4 An unvented system usually has the hot water storage vessel connected to the mains water supply via a backflow prevention device and a pressure-reducing valve, or supplied via a break-tank or booster pump set.

See also HSE's:

- [‘Managing the risks from hot water and surfaces’](#);
- chapter 10 on hot water and surfaces in [‘Health and safety in care homes’](#).

Hot water temperatures

10.5 Hot water is required in healthcare premises at various delivery temperatures for particular needs. The highest temperature, 55°C, is required typically in main kitchens, laundries, dirty utilities and food preparation

areas. Elsewhere the delivery temperature for personal hygiene will depend on individual preference for comfort and safety of patients who require assistance. In circulating hot water systems, the highest temperature will be required at all draw-offs on a loop. To achieve this, see Note 2 below, the flow from the calorifier/water heater is required to be at least 60°C at its outlet with a minimum return temperature to it at 50°C.

Notes

1. Requirements in the Water Supply (Water Fittings) Regulations 1999 and ACoPL8 are prescribed to ensure efficient use and appropriate control of microbial elements in hot water systems. Guidance to these dual requirements recommends that, to comply, hot water should be delivered to the outlet 50°C within 30 seconds and 55°C within 1 minute of an outlet being opened.
2. The flow temperature of hot water out of the calorifier should be a minimum of 60°C. It should be a minimum of 55°C on flow and returns to all outlets and at the start of the hot water return. It should be a minimum of 50°C at the final connection to the calorifier.
3. Water system design should negate the need for trace heating in healthcare premises.

10.6 The individual outlets, taps, mixing valves or other outlet devices will be served from the circulating distribution system; this should be designed such that the minimum temperature

on all return loops should be at a minimum of 55°C. This will ensure a temperature of 55°C at all outlets within a maximum of 1 minute.

Note

Where the hot water return is local to the outlet, a much quicker response should be achieved: less than 30 seconds (typically less than 10–20 seconds). Failure to achieve this may indicate a hot water return fault and should be noted during subordinate loop monitoring. See also [paragraph 10.59](#) on scalding risks.

10.7 A small number of localised hot water distribution systems can have advantages over one large centralised system. With smaller systems, hot water heaters are located closer to points of use, and it is therefore easier to maintain hot water distribution temperatures within recommended values. Balancing water flow rates in the hot water secondary distribution system becomes less of a problem, and distribution losses are reduced. A small localised hot water distribution system may comprise a gas-fired water heater or a storage calorifier. The adoption of localised hot water distribution systems will require the provision of local plantrooms.

10.8 With large centralised hot water systems, it is more difficult to maintain secondary distribution temperatures within recommended values; also, water flow rates in large secondary distribution systems can prove difficult to balance. This can be simplified by not overcomplicating the design for circulating systems (for example, by installing just one return to low level to accommodate the supply for two wash-hand basins back-to-back). See also [paragraphs 8.42–8.44](#).

10.9 There are also maintenance factors to be considered. With a central hot water system, plant maintenance can be focused in one location, whereas with localised systems there will be a number of plantrooms at remote locations.

Hot water heater types

10.10 In most healthcare premises, hot water storage vessels include the heating source, which can be steam, high- or medium-pressure hot water, or electric immersion heating elements. The flow to the pipeline distribution system is normally taken from the top of the vessel, as too is the open vent, which may or may not be combined. The cold feed and return pipe should be connected to the vessel at the lowest point. Instantaneous water heaters for distribution systems have similar pipeline connections. They should be designed to have minimum water storage below the elements and should not be run to feed further outlets downstream. All water heaters should have been assessed and shown to be mechanically and materially appropriate (for example, suitable approvals) for the intended purpose (see [paragraph 1.15](#)).

10.11 Traditional design practice is for the use of vented hot water systems, which rely on a cold stored water feed and vent pipe to maintain its safe operation (that is, preventing water exceeding 100°C and maintaining fixed system pressures). Upon heating, expanded water can travel along both the cold feed and open vent pipework.

10.12 Means should be taken to prevent thermal circulation of hot water from the water heater to the cold-feed cistern occurring, leading to conditions conducive to microbial colonisation (for example, *Legionella*). It is common for an anti-thermal cycling loop to be installed on the cold water feed pipe between the water heater and the vertical cold water feed pipe, such as a U- or S-bend pipe configuration. When this arrangement is used, no heated water should extend upstream of the bend into the vertical cold water feed pipe.

10.13 To preserve the quality of stored water within the cistern, the practice of terminating the vent pipe (air vent) over the cistern is no longer permitted. The vent should be arranged to discharge over a separate air-break-to-drain arrangement (in accordance with BS EN 1717) or a visible Type AA air gap, and sited at a level

that takes account of the hydrostatic head of the system (see G20.3 in the WRAS ‘Water Regulations Guide’ or Figure 7 of BS 8558) to prevent unwanted discharges. The tundish should discharge to drain.

10.14 The vent pipe is critical to the safe operation of vented hot water systems and should be situated in a hygienic environment to prevent blockages of the vent. The ingress of small animals, insects, debris or dust should be prevented. Vents should be designed to prevent unnecessary discharges of hot water and should be sized in accordance with G20.3 in the WRAS ‘Water Regulations Guide’ and to Figure 7 of BS 8558. Where screens are used on the vent outlet, additional measures should be included to ensure the continuing operation of the vent. Suitable maintenance should be specified to ensure the vent outlet is kept free from the collection of dust or biofilms etc.

10.15 The calorifier or water heater should be provided with a suitable safety valve of appropriate size and vacuum release arrangement.

10.16 Most vessels have some means of access for inspection, either via a special panel or by removing the heating coils/elements. When new calorifiers are required, it should be specified that they have separate and adequately sized access panels.

10.17 The combined storage capacity and heater output should be sufficient to ensure that the outflow temperature, at continuous design flow from calorifiers or other heaters, is not less than 60°C under maximum design flow. This applies to both circulating and non-circulating hot water systems. The positioning of the control and high-limit thermostats, cold feed and return water connections should ensure that these temperatures are achieved.

10.18 There are three types of water heater:

- a. instantaneous heater;
- b. storage calorifier;
- c. semi-storage calorifier.

Instantaneous water heaters

10.19 This type of heater can be further subdivided into:

- a. instantaneous water heaters for single- or multi-point outlets: 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 in essence:
 - i. the hot water flow rate is limited and is dependent on the heater’s power rating;
 - ii. the water in instantaneous water heaters is usually heated to about 55°C at its lowest rate, and its temperature will rise and fall inversely to its flow rate. Where constant flow temperature is important, the heater should be fitted with a water governor at its inflow. Close control of temperature is of particular importance for showers. To attain constant temperatures on delivery, water flow and pressure should also be controlled. Variations in pressure can cause flow and temperature problems when the heater is in use and when setting up or adjusting flow controls;
 - iii. they are susceptible to scale formation in hard water areas, where they will require frequent maintenance;
 - iv. this form of hot water heating should be considered only for smaller premises or where it is not economically viable to run a hot water circulation to a remote outlet;
 - v. for electrical instantaneous point-of-use showering, consideration should be given to selecting an appropriately thermostatically controlled product (for example, those with BEAB Care Mark approval).

Note

Some designs of combination water heater are arranged to have the cold-feed tank above the hot closed water tank. These are not recommended for healthcare premises, but where they are used, careful consideration should be given to managing the risks from these types of systems, and this should be reflected in the risk assessment. See also Table 1 in HTM 04-01 Part B.

- b. instantaneous-type water heaters for distribution systems: these devices, which normally use steam or high- or medium-pressure hot water as the primary heating medium, are designed to heat their rated throughput of water rapidly from cold to the design outlet temperature. They can be used either to feed directly into a hot water distribution system or in conjunction with a separate storage vessel (often referred to as a buffer vessel), which reduces the load on the heater during periods of peak demand. This type of heater includes:
 - i. hot water generators: these are vertical instantaneous water heaters that contain modular helical primary coils normally served by steam, medium temperature hot water (MTHW) or high temperature hot water (HTHW). The unit incorporates a temperature control device, which varies the rate of primary energy input so as to maintain a constant hot water flow temperature over a range of secondary flow rates through the heater;
 - ii. plate heat exchangers: plate heat exchangers consist of a number of rectangular plates sandwiched between two flat endplates and held together by tie bolts. The plates have ports in all four corners

that allow entry and discharge of the primary and secondary liquids. Primary liquid is directed through alternate pairs of plates while the domestic hot water is normally fed in a counter flow direction through the remaining pairs of plates. Each plate is sealed round the edges by a gasketing system, the design of which should ensure that fluids cannot, under normal operating conditions, either leak to atmosphere or mix. This type of heat exchanger can be extended easily, or shortened, to suit changes in hot water demand.

Storage calorifiers

10.20 Storage calorifiers are usually cylindrical vessels mounted either vertically or horizontally; the base of a vertical calorifier can be concave or convex, with the vessel being supported on feet. The latter design is preferred, as it avoids the annular space where the base joins the cylinder wall. Heater batteries are usually located near the bottom of the cylinder, which can give rise to an area of water beneath the battery significantly below the storage temperature. This “dead” area can provide an ideal breeding ground for bacteria. Galvanised cylinders are particularly susceptible to scale formation, which can also provide a source of nutrition and shelter for bacteria.

Note:

Galvanised cylinders are not recommended in new healthcare installations or for replacement.

10.21 The following points should be considered during the design process (see also paragraphs 10.27–10.28):

- a. the entire storage volume should be capable of being heated to 60°C without permanent pockets of lukewarm water;

- b. the shell lining should be resistant to bacterial growth;
- c. sufficient access to ensure adequate cleaning of the shell should be provided;
- d. a suitably-sized drain should be connected to the base of the calorifier.

Semi-storage calorifiers

10.22 These calorifiers can either have an independent heating facility such as oil or gas burners or electric elements, or use primary water/steam from a boiler to heat the water via a heat exchanger. The equipment is available in a range of storage capacities and recovery flow rates. This type of equipment is particularly suitable where systems are being decentralised and water heaters are required close to the point of use.

Sizing of hot water storage vessels

10.23 Storage should be calculated on the requirements of peak demand and the rate of heat input. There may be more than one peak period in each 24 hours. The interval between peak periods is important, as it affects the recovery time. See CIBSE Guide G: ‘Public health engineering’, which gives guidance on sizing hot water storage.

10.24 The installed hot water capacity should be sized for current needs and should not be designed with built-in capacity for future extensions.

10.25 Some devices are optimistically rated so that, at a continuous demand equal to their design rating, the flow temperature can fall below 60°C. Semi-storage or high-efficiency minimum storage calorifiers and instantaneous heaters are especially prone to this if under-sized.

Stratification in storage vessels, calorifiers, water heaters and associated buffer vessels

10.26 Stratification will occur in any storage calorifier, heater or associated buffer vessel; the temperature gradient will depend on the rate of draw-off and heat input. In some calorifier designs, stratification is significantly more pronounced and is a feature of their design. There will always be a volume of water in the temperature range that encourages maximum growth of *Legionella*.

Note

Stratification: in a storage calorifier, the upper level above the heating element will be at operating temperature (60°C) during normal periods of demand. Below this level there will be a volume of water at a temperature between that of the return feed water and the operating temperature. A higher return temperature is preferable to ensure all water in the calorifier can be stored above 60°C. This level will vary as draw-off takes place according to the thermal input and rate of demand.

10.27 Storage and semi-storage calorifiers should be provided with independently pumped circulation from the top to the base of the calorifier; this is referred to as a “shunt pump”. The pump should be run for long enough to ensure that the entire contents of the calorifier are raised to 60°C for an hour a day, often performed during periods of minimum demand. During periods of low draw-off, the temperature will readily achieve 60°C to effect disinfection. Control should be by a timing device that can be adjusted when the profile of demand has been established.

10.28 Some semi-storage/high-efficiency calorifiers are supplied with an integral pump that circulates water in the calorifier; in this case a second shunt pump is not required. A similar arrangement is included in some plate heat exchanger/storage vessel packaged systems where there is primary DHW circulation which

provides pasteurisation without the requirement of a further shunt pump on the vessel.

Unvented hot water systems

10.29 Hot water storage systems have traditionally been provided with an open vent pipe that relieves any steam generated in the event of failure of temperature controls. The open vent pipe also protects against rupture of the cylinder by expansion of water.

10.30 The use of unvented heating systems is covered in section G3 in Approved document G – ‘Sanitation, hot water safety and water efficiency’, which specifies the minimum safety precautions that should be taken when adopting such systems.

10.31 Where an unvented hot water system is connected directly to the water mains, no back-up will exist in the event of a water supply failure. Such an arrangement may also be unacceptable to the local water undertaker, since they will be required to meet the maximum demand at any time over a 24-hour period.

10.32 The design and installation of unvented hot water systems should comply fully with the Building Regulations and the Water Supply (Water Fittings) Regulations 1999.

10.33 The key requirements are that the temperature of stored water should be prevented at any time from exceeding 100°C and that discharges from safety devices should be conveyed to a safe and visible place and protected to prevent blockage and the ingress of birds, rodents or insects etc.

10.34 The discharge pipes from the temperature-relief valve and expansion valve should be carefully located so that they are readily visible – but do not present a risk to people – and protected to prevent blockage and the ingress of birds, rodents or insects etc.

10.35 Where the hot water is heated directly, for example by a steam or LTHW primary coil, a non-self-resetting thermal cut-out wired to a

motorised valve on the primary coil should be provided for control of excessive temperature. This should further be protected by a direct-acting protection device.

Connection arrangements for calorifiers and water heaters

10.36 Where more than one calorifier or heating device is used, they should be connected in parallel, taking care to ensure that the flow can be balanced so that the water temperature from all the calorifiers exceeds 60°C at all times.

10.37 Installations should not include for series operation of calorifiers/heaters.

Provisions for maintenance

10.38 There should be adequate access to calorifiers for inspection and cleaning, removal and replacement of tube bundles and removal and replacement of the entire calorifier.

10.39 All calorifiers and water heaters should be fitted with a drain valve located in an accessible position at the lowest point on the vessel so that accumulated sludge may be removed safely and effectively from the lowest point. The drain should be of sufficient size to empty the vessel in a reasonable time.

10.40 Drain valves should be of the ball type to avoid clogging, and a drainage gully should be provided of sufficient size to accommodate the flow from the calorifier drain.

Sealed expansion tanks for unvented hot water systems

10.41 It is essential that the expansion vessel is located on the cold feed rather than on the hot water side of the system in an area not subject to heat gain. All expansion vessels should have a means of isolation and drain provision to allow periodic flushing.

10.42 These vessels should be appropriately sized to take account of the thermal expansion of the hot water service system. Otherwise, they should comply with the recommendations in paragraphs 10.45.–10.48.

Hot water distribution system

10.43 To achieve the required circulating temperatures, it will be necessary to provide some form of regulation to balance the flow to individual pipe branches serving groups of draw-off points, for example each washroom/ toilet and en-suite facility.

10.44 The means of balancing the hot water circulation can be achieved by either manual or thermostatic regulating valves installed in the return loops to all outlets. There should be means of isolation, both upstream and downstream. Adequate access for servicing is also essential. Lock-shield valves should not be used for balancing.

10.45 In in-patient accommodation where en-suite facilities are provided, it is recommended that the hot water circulation be extended to draw-off points in series; for example, the supply to a basin, bath and/or shower should be run as one circuit (see Figure 6).

10.46 The operating pressures for both hot and cold water at draw-off points should be the same.

10.47 The domestic hot water system should not be used for heating purposes. This includes all radiators, towel rails, heated bedpan racks etc, whatever the pipework configuration.

10.48 Particular attention should be given to ensuring that pipework containing blended water should be kept to a minimum. Generally, the downstream supply from the mixing device should not exceed 2 m.

Note

The same restriction applies to communal blending, that is, where more than one outlet is served by one device. Central blending systems should not be used, since the length of distribution pipework containing water in the temperature range that supports *Legionella* growth would far exceed these maximum permissible lengths.

Hot water circulating pump

10.49 Hot water circulating pumps have traditionally been installed on either the flow or return. When installed on the flow, the arrangement comprises a full-bore non-return valve with a bypass into which the pump is installed (a non-return valve is also required in the return at the calorifier/water heater); appropriate valves and drain points are also required for servicing. The size of flow pipe is selected, with larger bores to begin with to ensure the maximum diversified simultaneous flow demand is achieved: the circulating pump bypass pipe size is selected to take account of the flow required to offset the heat losses in the flow and return pipework.

10.50 When installed in the return, the installation will require a downstream non-return valve, upstream and downstream isolation valves and drain valve. Installing the circulating pump in the return simplifies the valving arrangements and may improve circulation when draw-off is taking place. (During high demands, the flow from the calorifier may exceed that of the circulating pump in the flow resulting in the non-return valve at the calorifier closing.)

10.51 Duplex pumps should not be installed. A spare, clean, dry and ready-for-service replacement pump assembly with drain valve and non-return valve should be available in the event of failure of the service pump.

Note

If a permanently installed standby pump is considered to be essential, the control system should automatically change over operation every 3 hours.

10.52 The electrical connection should be by means of a lockable socket outlet for either single- or three-phase as required.

In-line strainers

10.53 Where not integral to the fitting, in-line strainers should be fitted within the water pipework system to protect vulnerable valves and fittings (pressure-reducing, safety-relief and stop valves, terminal fittings including thermostats and solenoid valves etc) against ingress of particulate matter. The installation of these fittings should allow adequate access for maintenance/replacement and they should be provided with means of upstream (and downstream where appropriate) isolation. Strainers can be a source of microbial contamination including *Legionella* and *Pseudomonas aeruginosa* and should be included in routine cleaning, maintenance and disinfection procedures (see Chapter 7 of HTM 04-01 Part B).

Cold-feed cisterns

10.54 When separate cold-feed cisterns are provided for hot water service installations, they should comply with the requirements for cold water systems.

Note

Hot water cylinders with an integral feed and expansion tank should not be used.

10.55 Some instantaneous water heaters include a flow-limiting device to ensure that the rate of draw-off does not exceed the capacity of the heater to achieve the required temperature. Such devices are not recommended for larger systems as air can

be introduced into the circulating system if taps are opened on upper floors during excess draw-off.

Service isolation valves

10.56 Service isolation valves should be fitted to all pipework preceding sanitary tapware and WCs etc for servicing, repair and replacement. These valves should not be used for balancing the hot water system. Drain-valve provision may also be appropriate for certain installations, for example service pipework to en-suite facilities. Care should be taken to ensure these do not constitute dead-legs. The design needs to ensure that there are enough isolation valves for maintenance and repair to allow essential services to continue (for example, on all riser connections and pipework entries to specific areas).

Water temperatures and delivery devices

10.57 With the change in focus towards improving the patient environment and minimising the risk of healthcare-associated infections, there has been an increase in the provision of single-bed rooms with en-suite facilities. Additionally, to promote good hand hygiene, wash-hand basin provision has increased significantly in all clinical areas. Effective hand-washing is best performed under running water at a safe, stable and comfortable temperature over basins/sinks (for clarification and design specifications, see HBN 00-10 Part C – ‘Sanitary assemblies’ and HBN 00-09 – ‘Infection control in the built environment’).

Note

The Water Supply (Water Fittings) Regulations 1999 place limits on the flow of water to draw-offs where plugs are not provided. Spray-type mixer taps are not recommended in healthcare premises; therefore, the type of tap should be carefully selected to minimise the formation of water droplets and aerosols. Water flow profile should be compatible with the shape of the wash-hand basin to avoid splashing. The fitting and basin combination should be such that the water stream never discharges directly into the basin's waste outlet (see HBN 00-10 Part C – 'Sanitary assemblies').

10.58 Components should be selected for their ability to minimise the accumulation of debris and splashing (including devices that deliver a smooth non-splashing/spraying flow), and to facilitate disinfection. See also [paragraph 3.1](#).

Note

When selecting new taps, HBN 00-09 advises against using aerators, strainers and flow restrictors at the point of discharge.

10.59 The risk of scalding for vulnerable patients (young children and older people, disabled people and those with neuropathy) is of particular concern in healthcare premises caring for such individuals, and therefore thermostatic mixing devices could be needed for hot water outlets. A risk assessment for scalding risk versus the risk of infection from waterborne pathogens should be undertaken by the WSG. (Thermostatic mixing valves should comply with HTM 04-01: Supplement – 'Performance specification D 08: thermostatic mixing valves (healthcare premises)'). See [Table 2](#) for recommended devices and outlets.

Table 2 Recommended devices and outlets

Activity/area	Maximum recommended set delivery temperature (°C)	Type of device
Areas where TMV type 3 valves should be fitted		Type 3 thermostatic mixing valve
Showers and hair-wash facilities	41	
Unassisted baths	44	
Baths for assisted bathing	46 – to allow for the cold mass of the bath. NB – prior to patient immersion, water should be checked with a thermometer.	
Bidets	38	

Note: Bath fill temperatures of more than 44°C should only be considered in exceptional circumstances where there are particular difficulties in achieving an adequate bathing temperature. If a temperature of more than 44°C is to be used, then a safe means of preventing access to the hot water should be devised to protect vulnerable patients.

Wash-hand basins and sinks

Wherever wash-hand basins are installed, a mixed water temperature outlet is required: a risk assessment should be undertaken, which is overseen by the WSG, that considers the needs of patients and service-users to determine whether there is a scalding risk and whether additional protection is required (e.g. a type 1 with temperature stop, type 2 or type 3 mixing valve – see options below). **Hazard warning signs for scalding risk should be displayed if appropriate.**

For outlets not intended for hand-washing (e.g. sinks in kitchens, dirty utilities or cleaners' rooms), TMVs should not be installed. **All installations require a hot water hazard warning sign.** (The temperature could equate to the maximum temperature available from the calorifier.)

Note: Microbiological risks should also be considered for all installations.

Options:

1. Separate hot and cold taps

2. Mixed temperature outlet:

- Type 1 – a mechanical mixing valve with or without temperature stop (i.e. manually blended)
- Type 2 – a thermostatic mixing valve: BS EN 1111 and or BS EN 1287
- Type 3 – a thermostatic mixing valve with enhanced performance: HTM 04-01: Supplement – 'Performance specification D 08: thermostatic mixing valves (healthcare premises)'

Type 3 TMVs should have undergone third-party testing and certification to the requirements of HTM 04-01: Supplement – 'Performance specification D 08: thermostatic mixing valves (healthcare premises)'.

Notes:

1. Where installed, it is preferable that thermostatic mixing devices are fitted directly to the mixed temperature outlet or be integral with it, and be the method of temperature and flow control, i.e. the mixing device should not be separate nor supply water via a second tap or manual mixer since there will be many cases where draw-off of cold water will not occur. If a separate thermostatic device is used, it should be fitted as close to the outlet as possible, which should be a flow-only control. Where "T" type mixing valves are installed, they should be readily accessible for maintenance.
2. In the case of bidets with ascending sprays or a handle douche, which may be accidentally immersed, the water supply should be independently fed from storage with no draw-offs at a lower level (i.e. a break-tank arrangement). Appropriate backflow protection must be provided (see [paragraphs 12.18–12.24](#)).

3. Automatic taps (timed flow) can be considered as a result of a risk assessment and should be specified as appropriate for the conditions of use, either type 2 or 3. If the temperature is non-user adjustable, they should be supplied via a type 2 or 3 TMV set to 39–40°C. The sensors should include a timer that can be adjusted to take account of the optimum washing time: this is particularly for scrub sinks. Sensors should be offset or positioned such as to reduce the risk of accidental contamination of the outlet and be positioned so that POU filters can be used. Facilities for overriding the sensors will be necessary. When a duty cycle setting exists, it should be activated to avoid stagnation. (If there is more than one tap/outlet, e.g. in the case of scrub sinks, then all should deliver water to avoid stagnation.)
4. In the case of dual-function delivery devices, i.e. bath/shower diverter, type 3 valves should deliver the temperature appropriate to each outlet e.g. bath max 44°C or 46°C, shower 41°C. (Refer also to the commissioning procedure section in HTM 04-01: Supplement – ‘Performance specification D 08: thermostatic mixing valves (healthcare premises)’.)
5. Taps, components and fittings should be removable and easily dismantled for cleaning and disinfection.
6. Where manual mixing devices with a temperature stop are installed, it is important to ensure that the normal maximum delivery temperature is controlled to safe limits. Installation, commissioning and maintenance should take account of the system’s dynamic pressure and temperature changes, and the seasonal changes in incoming cold water temperatures.
7. This table does not cover birthing pools. (See “[Areas this HTM does not cover](#)” in Chapter 1.)

Showers

10.60 Showers with fixed heads are preferred for prevention of backflow (see [paragraphs 12.18–12.24](#)) and minimisation of contamination. Where flexible hoses and moveable shower outlets are provided, the outlet should not be capable of being accidentally immersed into a drain, WC or other potential source of contamination. They should be selected based on ease of cleaning, descaling and disinfection.

10.61 The flow of some showerheads can be adjusted by selecting different sets of nozzles (fine spray, pulsating flow etc); as this will exacerbate possible stagnation problems, they should not be installed in healthcare premises.

10.62 Thermostatic mixing valves should be accessible in such a way as to prevent damage to the shower installation, the supply pipework or the removable panels themselves in wet areas. Access for safe inspection and removal should be given high priority.

11 Building management systems

11.1 The continued safe operation of domestic hot and cold water systems requires a number of routine checks to be made by physical means using separate thermometric equipment. A number of the control parameters can, however, be continuously monitored by building management systems (BMS) even though routine checks will still be required for calibration purposes. Parameters that should be monitored are as follows:

- a. incoming mains temperature (at the water meter), inlet, outlet, and surface water temperatures of cisterns and cold water feed tanks for hot water calorifiers;
- b. temperatures for calorifier flow and returns, and the returns on each loop;
- c. hot water service return temperatures on all primary loops;

Note

In non-recirculating hot and cold systems, at least two points, including the furthest from the entry of the pipe into the department, should be monitored. In other departments, monitoring should be provided on a similar basis.

- d. cold water service at furthest point and in a location that demonstrates general temperature representation within the ward/department;
- e. consideration should be given to the frequency, timing and monitoring of taps etc with automatic flushing devices.

11.2 In addition to temperature, the BMS should monitor pressurisation and circulating pumps and water treatment systems for fault conditions or change of status likely to result in a fault. There should be a documented procedure for regularly checking the BMS for such alarms.

12 Pipework installations

12.1 All hot and cold water pipework should be designed and installed in full accordance with the Water Supply (Water Fittings) Regulations 1999 and relevant parts of BS EN 805, BS EN 806-2 and BS 8558.

12.2 Within the system, it is essential to include facilities for measuring, regulating, isolating, venting, draining and controlling the flow of water. Regulating valves with built-in pressure tappings or orifice plates with manometer tappings will be required for the measurement of pressure drop, which enables the volume rates of flow to be determined. Care should be taken to ensure that regulating valves or orifice plates are sited well away from bends or fittings.

Sizing

12.3 Pipes should be capable of a rate of flow to satisfy the combined maximum demand of all the services to be supplied. All the maximum demands of the separate services may not occur simultaneously, and the actual combined maximum demand may be a proportion of the sum of the separate maximum demands, which will be determined by the number and character of the services.

12.4 Hot and cold water pipework should be sized using the procedure outlined in CIBSE's Guide G – 'Public health engineering'.

Pipe branches

12.5 Pipe branches should be designed with the aim of avoiding stagnation. As far as practical, the maximum length of any pipework between a terminal device and a recirculating

system or a cold water distribution mains should be kept to a minimum; generally, the complete length of the spur should not exceed 3 m. The length is measured from the centre line of the circulation pipework to the point of discharge along the centre line of the pipework. These pipes should be insulated.

Routing of pipework

12.6 Pipework in buildings should be designed and routed:

- so that minimal heat transfer will occur between hot and cold or the surrounding environment (see also [paragraph 9.2](#)); and
- in a manner that will promote good turnover of water, particularly in cold water service systems.

12.7 All pipework should be accessible for inspection, maintenance and repair as far as is practicable. Ducts, trenches and chases containing pipework should be large enough to facilitate repairs.

Buried pipelines

12.8 Pipelines made of plastics are susceptible to hydrocarbons such as fuels and oils. These chemicals can travel through plastic pipes if they are nearby and contaminate the water supply, and it may take days, weeks or even months before a noticeable taste can be detected in the water supply. Whenever spills are reported, an assessment of services within the area should be undertaken (see WIS 4-32-19 and UKWIR's '[Guidance for the selection of water supply pipes to be used in brownfield sites](#)').

12.9 Pipework distribution networks should be divided into sections by the provision of isolating valves in accessible locations to facilitate isolation for repairs, maintenance and flushing.

12.10 Underground mains need not be laid at unvarying gradients but may follow the general contour of the ground. As far as possible, however, they should fall continuously towards drain points and rise continuously towards the air vent. They should not rise above the hydraulic gradient; that is, there should always be a positive pressure, greater than atmospheric, at every point under working conditions. The gradient between air release and drainage valves should be not less than 1:500 rising in the direction of flow and not less than 1:200 falling in the direction of flow.

12.11 Underground pipes entering a building should do so with a cover of not less than 0.75 m below the external ground surface and should pass through the wall within a watertight built-in sleeve. The sleeve should be filled in around the pipe with a suitable material for a minimum length of 152 mm at both ends to prevent the ingress of water or vermin. External underground pipes should be at a depth, or otherwise sufficiently protected, to prevent damage by traffic and any consequent vibrations. A minimum depth under roadways of 1 m measured from the top of the pipe to the surface of the roadway is necessary. In other underground locations the depth should not be less than 0.75 m, subject to this depth being sufficient protection against frost (frost penetration depends on the nature of the subsoil and the ground surface). Freezing can occur at depths of up to 1.1 m (see paragraph 13.26). Local information on the prevalence of frost should be sought (see also paragraphs 13.25–13.29).

12.12 Marker tapes should be laid over the whole length of all underground water services pipework (see also the requirements in BS 1710). The tapes should be clearly marked with the description of the service and should be coloured blue and red for fire mains.

Vents and drains

12.13 Air-release valves should be provided at summits and drainage valves at low points between summits unless adequate provision is made for the discharge of air and water by the presence of service connections. Large-orifice air valves will discharge displaced air when mains are being charged with water. When air is liable to collect at summits under ordinary conditions of flow, small orifice air valves, which discharge air under pressure, may be required. “Double-acting” air valves having both large and small orifices should be provided where necessary. Air-valve chambers should be adequately drained to avoid the possibility of contamination.

12.14 Automatic air-release valves should be installed where accessible for maintenance. Installation in ceiling voids is not recommended.

12.15 Drain points should not discharge directly into a drain or sewer or into a manhole or chamber connected thereto without an appropriate air gap between the water system and the drain. This can be achieved with a Type AA air gap or an air-break-to-drain device in accordance with BS EN 1717 clause 9. Where a wash-out discharges into a natural watercourse, the discharge should at all times be well above the highest possible water level in the watercourse. Consent for this discharge may be required from the Environment Agency. In some cases it may be necessary for the wash-out to discharge into a watertight sump, which has to be emptied while in use by portable pumping equipment.

12.16 In order to minimise quantities of water that may collect in stub pipes at drain points, the length of such stub pipes should be kept to an absolute minimum. This relates in particular to drains from hot water calorifiers, storage cisterns and distribution pipework.

Valves

12.17 A clear indication should be given on all valves of the direction of rotation needed

to close the valve. Normal practice is to have clockwise closing when looking down on the valve.

12.18 Where blending valves have been installed at the end of a run of hot water pipework, consideration should be given to the inclusion of a drain valve adjacent to the mixer. This should be located upstream of the mixing valve so as to facilitate flushing out and routine temperature testing of the hot water without having to dismantle the blending valve.

Backflow protection and the prevention of contamination

12.19 In all cold water installations it is important that adequate protection be provided to all supplies against backflow. In a healthcare facility, there should be a high degree of protection not only to the water in the undertaker's mains, but also within the facility's installations to protect the patients and staff. Instances of water use in healthcare facilities where backflow is likely to be harmful to health include bidets, bedpan washers, dental spittoons and equipment, mortuary equipment, and water outlets located in laboratories.

12.20 In addition to backflow protection at all points of use, the whole installation protection should be provided as required by the Water Supply (Water Fittings) Regulations 1999.

12.21 Healthcare buildings and medical premises have been identified as involving Fluid Category 5 backflow risks (see Schedule 1 "Fluid Categories" from the Water Supply (Water Fittings) Regulations 1999), which are defined as points of use or delivery of water where backflow is likely to involve fluids contaminated with human waste or pathogens. Within healthcare facilities, water usage covers a wide range of applications, from domestic use by patients and staff to specialised use in operating departments and pathology laboratories, and with equipment such as bedpan washers and haemodialysis machines. Even within high-risk specialist areas such as

pathology laboratories (see paragraph 13.22), further separation of water supplies may be required to protect water used for domestic uses from those high-risk applications. In addition, many apparently "commercial" usages may be classed as high-risk because they are for healthcare purposes (such as centralised laundries).

12.22 Where any doubt exists with regard to the level of protection required against water supply contamination, reference should be made to the Water Supply (Water Fittings) Regulations 1999 and guidance contained in the WRAS 'Water Regulations Guide', or to the water undertaker.

12.23 The Water Supply (Water Fittings) Regulations 1999 require the identification, by colour-coding or labelling, of all pipework carrying fluids other than wholesome water. This includes plumbed-in equipment used for diagnostic and treatment purposes (see BS 1710).

12.24 New systems should not include legs of pipework for potential future extensions to the system as these will create stagnant legs. Any alterations to existing systems – or where redundant pipework is found – should be cut back to the connection point; this includes replacing the branch 'T' with a straight coupling.

12.25 Certain departments such as pathology laboratories present particular risks of water contamination. Attention is drawn to section G15.24 in the WRAS 'Water Regulations Guide' on supplementing point-of-use protection by zone protection, where the pipes supplying a high-risk area can be given additional protection by installation of a secondary backflow protection device.

Frost protection

12.26 The Water Supply (Water Fittings) Regulations 1999 require that all cold water pipework and fittings be adequately protected against damage from freezing.

12.27 In the case of external pipework that is run underground, the Regulations require that consent be sought from the water supplier if pipes are to be run at depths of less than 0.75 m or greater than 1.35 m. Permission from the water undertaker should be sought if any deviation is required.

12.28 Particular care is required when routing pipework externally above ground or through unheated areas within buildings. The WRAS 'Water Regulations Guide' gives guidance on the minimum thickness of thermal insulating materials that should be applied in such cases (see the online calculation tool on the [WRAS website](#)).

12.29 Adequate provisions for isolating and draining sections of cold water distribution pipework will ensure that disruption caused by frost damage can be minimised.

12.30 For further guidance on frost protection, refer to the WRAS 'Water Regulations Guide'.

Maintaining cleanliness and hygiene

12.31 To prevent the risk of seeding the water system during construction and installation, care should be taken to prevent the ingress of contaminants and particulate matter into pipework, fittings and cylinders etc. Blanking flanges, plugs and caps should not be removed until connections need to be made. Open ends of pipes should be recapped when work ceases. Particular attention should be taken when pipes are passed through partitions etc and when transporting items from storage to installation locations.

13 Noise and vibration

Pump noise

13.1 Noise generated by centrifugal pumps will not cause problems if water velocity in the pipes and the speed of the pumps are low, for example about 1 m/s and 960 rpm respectively.

13.2 Care should be taken in locating water-boosting pumps within healthcare buildings to ensure that they will not cause interference to in-patient accommodation and other quiet zones.

13.3 Such interference may result from break-out noise from the boosting equipment, or noise transmitted through the pipework system or through the building structure. Pump noise may also result from cavitation caused by low suction head.

13.4 Where pumps are located close to sensitive areas, provision for noise and vibration reduction should be incorporated in the design. Such provision will include selection of quiet-running motors, vibration isolation of boosting equipment from pipework and structure and, if required, acoustic lining to the booster plant enclosure.

13.5 Guidance on recommended noise levels for various locations is given in CIBSE's Guide A – 'Environmental design'. See also HTM 08-01 – 'Acoustics'.

Other forms of system noise

13.6 Other forms of nuisance noise that may be generated by hot and cold water distribution systems are listed below:

- a. noise from pipework due to excessive water velocity;
- b. water hammer caused by rapid closure of valves or taps;
- c. oscillation of the float of a float-operated valve;
- d. tap washer oscillation;
- e. noise caused by water discharging from float-operated valves into cisterns;
- f. noise caused by thermal movement of pipes;
- g. noise due to trapping of air within pipework, particularly on hot water systems.

13.7 Further details on the above sources of noise, including guidance on avoiding such noise problems, are given in the WRAS 'Water Regulations Guide'.

14 Water economy and energy conservation

Water

14.1 Hot and cold water distribution systems for healthcare buildings should be designed so as to minimise the use of water. The cold water distribution systems should incorporate an adequate number of water meters to allow for close monitoring of water consumption. Where practicable, consideration should be given to linking water meters to a building management system or an automatic metering system.

14.2 Measures to optimise water consumption – and yet avoid risk of stagnation – that should be considered at design stage include:

- a. provision of automatic systems to control flushing of urinals;
- b. use of showers rather than baths wherever practicable;
- c. WC pans and flushing cisterns that use more than 6 L per flush are prohibited by Water Supply (Water Fittings) Regulations 1999;
- d. control of water pressure to a level that is not excessive for the purpose required;
- e. use of self-closing or non-concussive taps in appropriate circumstances;
- f. locating warning pipes from cisterns and discharge pipes from relief valves in such a way that any discharge can be readily observed, and/or fitting alarms on such pipes.

14.3 Further guidance on the prevention of wastage of water is given in the WRAS 'Water Regulations Guide'. See also HTM 07-04 – 'Water management and water efficiency'.

Energy

14.4 Hot and cold water systems should be designed to operate by gravity as far as possible. Where water-boosting pumps are necessary, the pump motors should be selected to operate at maximum efficiency at the required duty.

14.5 The practice of pre-heating of the cold feed to calorifiers should not be carried out. The only time it is acceptable is when under all flow/demand conditions a temperature greater than 45°C can be guaranteed at the entry to the calorifier. Any pre-heater should have a low water capacity. Heat recovery/systems for pre-heating water for domestic purposes should not be installed in healthcare premises unless there are adequate fail-safe measures in place to ensure that the hot water distribution system is not compromised.

14.6 Further guidance on energy conservation in relation to hot and cold water systems is given in HTM 07-02 – 'Encode' (see also the [Carbon Trust's website](#)).

15 Installation, testing and commissioning

See also Chapter 11 on commissioning in HTM 04-01: Supplement – ‘Performance specification D 08: thermostatic mixing valves (healthcare premises)’.

15.1 While testing and commissioning is regarded as a discrete activity, continuous monitoring is required throughout the installation to ensure that:

- a. materials and equipment installed comply with the Water Supply (Water Fittings) Regulations 1999 and other British Standards, and are not otherwise unsuitable. For example, equipment has been assessed and shown mechanically and materially to be appropriate (for example, suitable approvals) for the intended purpose (see [paragraph 1.15](#)) and has been installed in accordance with any relevant conditions;
- b. the work is done entirely within the specification for the scheme;
- c. 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.

Installation checks

15.2 The system should be regularly checked during installation to ensure that open pipes, valve ends, cylinder connections etc are sealed to prevent the ingress of dust/debris that could

cause problems during commissioning and subsequent operation (see [paragraph 12.30](#)). Checks should also be made to ensure that lead solders are not being used.

Commissioning

15.3 Correct commissioning is vitally important for the satisfactory operation and long-term control of hot and cold water systems. Where buildings are to be occupied in stages, the systems should be commissioned in stages as occupation is anticipated. The design team should prepare a commissioning brief for use by the contractor’s commissioning engineer which has been agreed as suitable for purpose by the WSG with input from specialist external advisers if necessary.

15.4 A water risk assessment and associated method statements should be prepared by the design team and contractors, and this should be agreed by the WSG before commissioning begins. As commissioning correctly is such an important step in ensuring the safety of the building for the rest of its life-cycle, estates departments should ensure competent staff are available for witnessing key stages.

15.5 The water system should be filled as late in the commissioning process as possible. The design team should consider using inert gas for pressure-testing when possible. The system should be flushed to remove all flux and debris before being filled with water as soon as possible, but within a maximum of 48 hours, to prevent biofilm development and corrosion. Wholesome water should be used for flushing. Treated water should be available for top-up as necessary during the commissioning process.

All strainers should be cleaned after flushing and before final filling.

15.6 After water has been introduced into the system, a flushing regime should be introduced to maintain the wholesomeness of the water content.

15.7 It is essential that the results of all checks and measurements are recorded in writing at the time they are made. Breaks in the continuity of commissioning operations are likely, and proper records will show the state of progress at any stage. It is most important that commissioning records are provided as part of the handover information.

15.8 The commissioning brief should specify fully and clearly the extent of the commissioning, the competencies of the personnel to be carrying out the process and the objectives which should be achieved, and should include:

- a. full design data on temperatures, water flow rates and pressures;
- b. plant and equipment data;
- c. number of commissioning procedures for thermostatic mixing valves in accordance with Chapter 11 of HTM 04-01: Supplement – ‘Performance specification D 08: thermostatic mixing valves (healthcare premises)’;
- d. drawings and schematics;
- e. a list of test certificates to be provided.

15.9 The design team’s attention is drawn to CIBSE’s Commissioning Code W – ‘Water distribution’, which provides guidance on information that will be required by the commissioning engineers.

15.10 In the preparation of commissioning instructions for domestic hot and cold water services, design teams should ensure that their work is in accordance with up-to-date guidance.

15.11 The design team should prepare for inclusion in the contract documents a list of tests and measurements that are to be taken by the contractor and recorded by him/her. These should be witnessed by the contract supervising officer or project engineer on his/her behalf and he/she, if approved, will circulate the results, in accordance with the client’s instructions.

15.12 The installation, on completion, should be operated by the contractor as a whole, and subjected to functional or performance tests as specified by the design team.

15.13 The commissioning manual should be prepared by the contractor and submitted to the client’s commissioning adviser and the WSG (with support from their specialist adviser if required) for review before being issued in final form.

15.14 Typical schedules of checks and performance tests should be included in the commissioning manual together with record sheets. These should be amended and supplemented as the design team considers necessary.

15.15 Once the client’s commissioning adviser is satisfied that the system meets the design intent, the final accordance record sheets should be completed. If performance is not acceptable, the matter should be dealt with in accordance with the contract requirements.

15.16 The supervising officer or project engineer, who should countersign any relevant test record documents, should witness commissioning and testing.

15.17 “As installed” record drawings, schematic diagrams, and operating and maintenance instructions should be supplied at the time of handover. Certified records of pressure-testing and disinfection should also be made available.

15.18 The whole commissioning procedure should be carried out under the guidance of a single authority, although the involvement of specialists or manufacturers may be required for specific items of plant.

15.19 Valid calibration certificates should be submitted and checked for all measuring equipment to be used by the commissioning engineers before the start of the commissioning phase.

15.20 The commissioning should be carried out in a logical and methodical manner.

15.21 The installation, on completion, should be operated by the contractor as a whole, and subjected to specified functional or performance tests.

15.22 Once the system meets the design intent, the final completion record sheet(s) should be completed. In the event of performance not being acceptable, the matter should be dealt with in accordance with the contract requirements.

Commissioning and testing checklists

15.23 The following is a summary of the key activities associated with pre-commissioning and commissioning of hot and cold water storage and distribution systems. The list is not intended to be comprehensive.

Note

Before water is introduced into any part of the system, checks should be carried out to determine that appropriate backflow prevention measures have been implemented (see [paragraph 9.10](#)).

Cold water installations

15.24 Pre-commissioning checks can be carried out on completion of the system installation, filling and pressure-testing.

15.25 Pre-commissioning checks and tests to be applied are as follows. Check that:

- a. systems have been provided and installed in accordance with specification and drawings, and that

the systems are charged with water, vented and free from leaks;

- b. water storage cisterns are free from distortion and leaks, are properly supported and secured, are provided with correctly fitting covers, and are in accordance with the Water Supply (Water Fittings) Regulations 1999;
- c. distribution pipework is rigidly supported, insulated, and incorporates adequate provisions for venting, draining, expansion, isolation and measurement of flow, temperature and pressure;
- d. pipework systems have been pressure-tested;

Note

Except where otherwise specified, testing of underground pipelines should be carried out in accordance with the requirements of the Water Supply (Water Fittings) Regulations 1999.

- e. pipework systems and storage/break-tanks are correctly identified and marked;
- f. regulating valves and flow control devices operate freely;
- g. water meter(s) is/are fitted correctly;
- h. electrical isolation, cross-bonding and wiring of system components are installed in accordance with the current edition of BS 7671.

Hot water installations

15.26 Pre-commissioning checks can be carried out upon completion of system installation, filling and pressure-testing.

Note

Before water is introduced into any part of the system, checks should be carried out to determine that appropriate backflow prevention measures have been implemented (see [paragraph 10.10](#)).

15.27 Pre-commissioning checks and tests to be applied are as follows. Check that:

- a. systems have been provided and installed in accordance with the specification and drawings;
- b. the system is charged with cold water, vented, and free from leaks;
- c. hot water storage vessels are free from leaks and are properly supported and secured;
- d. distribution pipework is rigidly supported, insulated, and incorporates adequate provision for venting, drainage, expansion, isolation, and measurement of flow, temperature and pressure;
- e. pipework systems, storage cylinders etc have been pressure-tested;
- f. pipework systems, calorifiers and cisterns are correctly identified and marked;
- g. regulating valves and flow control devices operate freely;
- h. all control and regulating valves are labelled or marked to correspond with reference numbers on contract drawings;
- i. electrical isolation, cross-bonding and wiring of system components is installed in accordance with the current edition of BS 7671;
- j. up-to-date system schematics are displayed in a frame in the relevant plantroom.

Commissioning checks of hot and cold water systems

15.28 Upon satisfactory completion of the pre-commissioning checks, the systems should be cleaned, disinfected and flushed before refilling. Advice on cleaning and disinfection is given in HSG274 Part 2. (See also paragraphs 16.42–16.44 for guidance on the safe discharge of wastewater used during disinfection procedures.)

15.29 Commissioning checks and tests to be applied are as follows. Check that:

- a. drain-down points flow when released and are free from leaks when shut, that air vents and release valves open correctly and are airtight when shut off, and that overflows run freely and discharged water does not cause flooding or damage;
- b. float-operated valves function satisfactorily and are adjusted to achieve the correct water level;
- c. all temperature and other controls are adjusted and calibrated to agreed design limits of system performance;
- d. all electrical circuits are tested and the pump motor direction of rotation is correct, and that electrical controls and alarms function correctly;
- e. operation of any safety or anti-flood device is satisfactory;
- f. circulating and pressurisation pumps are free from excessive noise, vibration and leaks and that pressurisation vessels are filled to the correct water level;
- g. expansion vessels where installed are filled to the correct water level;
- h. control valves operate correctly and shut-off valves close tightly;
- i. heat exchangers operate satisfactorily;

- j. primary heating circuits are adjusted and regulated, and thermostatic settings are correct; and that bypass circuits and automatic control valves operate correctly;
- k. remote and automatic control of pumps (if appropriate) is satisfactory, and there are no leaks at joints under maximum flow conditions;
- l. the cold water and hot water circulating and distribution systems are vented and regulated;
- m. thermostatic mixing devices and regulating valves are adjusted and set to desired values (TMVs require hot and cold water for testing and commissioning, and should be commissioned in accordance with Chapter 11 of HTM 04-01: Supplement – ‘Performance specification D 08: thermostatic mixing valves (healthcare premises)’);
- n. all taps, mixers and outlets operate satisfactorily and that all strainers and shower outlets have been cleaned and are free from contamination;
- o. water flow quantities at all plant items, regulating valves and flow-measuring valves are recorded;
- p. mass flow rates from taps, main and other outlets in positions shown on contract drawings are satisfactory;
- q. pressure drop at heat exchangers at full design demand flow is tested and recorded;
- r. hydraulic balancing of hot water secondary circulation system is carried out to ensure that minimum temperatures are achieved in all parts of the circuit;
- s. full load current of components does not exceed the recommended values;

- t. the running current of components does not exceed the recommended values;
- u. pump thermal overload trips are set.

Temperature testing

15.30 These tests should be performed and validated prior to contractual handover and bringing the system into use and when in occupation. Separate thermostatic 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.

15.31 Tests should include:

- a. measuring the incoming water temperature at the main water meter;
- b. testing the inlet, outlet and surface water temperatures of cisterns and cold water feed/header tanks for the hot water calorifiers and water heaters. The temperature should be close to the water temperature of the incoming water;
- c. testing the flow and return temperatures at connections to calorifiers and water heaters. These should not be less than 60°C and 50°C respectively;
- d. testing the temperature in branches of hot water circulating systems installed in all departments to ensure that the system has been balanced, and that under “no draw-off” conditions 55°C is achieved in the circulating system at all outlets;
- e. testing single cold water outlets and the cold water inlet to mixing valves to ensure temperature equilibrium below 20°C.

Sampling

15.32 The WSG should discuss and agree a sampling regime and appropriate parameters (physical, chemical and microbiological) depending on the intended use of the system and vulnerability of the patients. This should be agreed prior to tender.

15.33 Sampling should be carried out prior to any construction/refurbishment works and immediately prior to handover, but no sooner than 48 hours after disinfection. It is recommended that sampling is undertaken by an accredited organisation independent of the contractor.

Chlorine dioxide systems

15.34 Allowance should be made for the type of residual present in the incoming supply as part of the strategy for additional disinfection within premises. The dosage of chlorine dioxide should be proportional to the water flow and the dosing system should incorporate safeguards to prevent inadvertent overdosing. In the case of hot water distribution systems with calorifiers/water heaters 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 concentration of total oxidant should be found in the hot water, although this should be far less than the 0.5 mg/L injected.

15.35 The required dose should be determined by incremental addition until it reaches a concentration that provides adequate preservation of water quality but should not exceed 0.5mg/L. The failsafe operation of the system plus any leak detection installed should be witnessed and verified.

Note 1

Initially during the commissioning process it may be necessary to maintain a higher dosage rate than 0.5mg/L.

Note 2

Excessive values of chlorine dioxide should be avoided subsequently since it can corrode copper and steel pipework and can also damage non-metallic pipework and component parts, particularly at higher temperatures.

15.36 Guidance on chlorine dioxide systems is given in HSG274 Part 2.

Copper and silver ionisation

15.37 Values of more than 0.2 mg/L copper and more than 0.02 mg/L silver are recommended at outlets to ensure effective control of *Legionella*. Analysis for silver and copper should be carried out by a UKAS-accredited laboratory.

15.38 Maintaining adequate silver/copper ion concentration in hard water systems can be difficult as a result of the build-up of scale on the electrodes potentially obstructing copper and ion release. Consequently more frequent checks will be necessary to ensure that the system is delivering adequate ion values. (The ionisation process of pH sensitive and dosing may need to be increased for pH values greater than 7.6.)

Note

The Water Supply (Water Quality) Regulations 2000 set a standard for copper of 2 mg/L, which must not be exceeded. However, there is currently no standard for silver used for domestic purposes. At the time of publication the European Union and WHO do not dictate any standards for silver as there is currently insufficient data for recommending a concentration limit. Equipment manufacturers generally recommend copper (0.2–0.8 mg/L) and silver (0.02–0.08 mg/L) ion concentrations to control *Legionella* effectively. See also paragraphs 5.18–5.20.

15.39 Where some of the outlets on the treated water systems are to be used for domestic purposes, regular water testing needs to be maintained to ensure that the copper concentration does not exceed 2.0 mg/L as Cu and the silver level does not exceed 0.1 mg/L as Ag at these outlets.

15.40 Guidance on silver and copper ionisation systems is given in HSG274 Part 2.

Other water treatment systems

15.41 A range of biocidal treatment systems are available, and further advice on their use is given in HSG274 Part 2.

Maintaining control of systems

15.42 After commissioning and prior to occupancy, it is essential to put in place measures to ensure that wholesome water and hot and cold water temperatures are maintained throughout the system. This will require regular flushing as determined by the WSG and associated risk assessments (see also clauses 2.40–2.52 in HSG274 Part 2).

Note

Once filled, systems should not be drained unless full disinfection is to be carried out prior to building occupancy and use. However, allowing water in newly installed capillary-jointed copper plumbing to stagnate can result in serious corrosion of the copper.

Discharge of wastewater used during disinfection procedures within buildings

15.43 Contaminated water from disinfection procedures that is run to waste, be it to a natural watercourse or sewer, can potentially result in a pollution hazard or affect the efficacy of a sewage treatment plant. It is therefore important that the appropriate consent to discharge is obtained prior to disposing of the contaminated water.

15.44 Where water from disinfection procedures is to be discharged into a watercourse or into a drain leading to a watercourse, consent to discharge should be obtained from the appropriate authority (the Environment Agency in England and Wales, the Scottish Environmental Protection Agency in Scotland, and the Department of the Environment for Northern Ireland in Northern Ireland).

15.45 Water from disinfection procedures may be classed as trade effluent and, prior to any discharge into a sewer or sewerage system, consent to discharge should be sought from the local water company that provides the sewage and trade effluent services to the site (sewerage undertaker). (See also page 33 of HBN 00-07 and also guidance from [Water UK](#).)

Note

Dependent on the geographical location of the site with respect to the operational boundaries of water companies, the duties of the water undertaker and sewerage undertaker may be provided by two different companies.

16 Documentation

16.1 It is essential that a full report of all commissioning and testing activities is compiled and handed over to be incorporated within the operation and maintenance manuals.

16.2 These commissioning and testing records will be required so that subsequent maintenance and periodic checks can be made to ensure that the installation continues to operate as intended. Such information will include:

- results of temperature checks on the cold water supply;
- results of temperature checks on hot water circulating systems and trace-heated hot water installations; and
- commissioning and in-service test data for type 3 and type 2 TMVs (see Chapter 11 of HTM 04-01: Supplement – ‘Performance specification D 08: thermostatic mixing valves (healthcare premises)’).

The information should also include identification of, and test results for, sentinel taps.

16.3 Where continuous water treatment is installed, the commissioning records should include details of settings of the equipment, dosing rates and requirements for testing.

16.4 Operation and maintenance manuals should be in accordance with BSRIA’s Building Applications Guide BG1/2007 – ‘Handover O&M manuals and project feedback’.

16.5 As a minimum, for new installations or major refurbishment, the contract should require the following documents and drawings to be supplied:

- a. full manufacturing details, including batch numbers of all pipes and fittings;
- b. (in accordance with BS 8580) a risk assessment for the control of *Legionella*;
- c. full records and certificates of pressure tests for all sections of pipework;
- d. settings of all balancing valves, with readings of flow rates where applicable;
- e. full details of each item of plant, including arrangement drawings and appropriate test certificates;
- f. as-fitted drawings showing clearly the location of balancing valves, flows and settings, isolation valves, drain valves;
- g. schematic drawings for installation in plantrooms showing all valves and items of plant;
- h. full details of water treatment parameters and operating modes and settings;
- i. full details of maintenance requirements;

- j. detailed confirmation of disinfection procedures to BS EN 806 series (parts 1–5) and BS 8558 and results of post-disinfection microbiological analysis;
- k. full records confirming that all materials and fittings hold WRAS or equivalent accreditation;
- l. expected operational conditions of the water system (that is, expected pressures, expected temperatures, expected flow rate throughout the system as pressure drops will occur etc).

Appendix 1 Impact of water consumption on care pathways

Water figures per unit of healthcare activity are published by the NHS Sustainable Development Unit (NHS SDU):

<http://www.sduhealth.org.uk/areas-of-focus/carbon-hotspots/pharmaceuticals/cspm/sustainable-care-pathways-guidance.aspx>

Estates Return Information Collection (ERIC) data on total water consumption (litres per day per floor area) for each type of healthcare organisation can be found at: <http://hefs.hscic.gov.uk/>

Appendix 2 Overview of UK water legislation and regulation

The table below shows the principal acts and secondary legislation created to regulate the provision of public and private water supplies in the UK.

Legislation

Legislation	England	Northern Ireland	Scotland	Wales
Primary Legislation – Principal Acts	Water Industry Act 1991 (as amended)	The Water and Sewerage Services (Northern Ireland) Order 2006 (as amended)	Water (Scotland) Act 1980 (as amended) and Water Industry (Scotland) Act 2002	Water Industry Act 1991 (as amended)
Powers and Offences provided by the Principal Acts which can be used in relation Water Fittings Regulations enforcement	Water Industry Act 1991; Section 73 & 75	The Water and Sewerage Services (Northern Ireland) Order 2006; Articles 113 & 115	Water (Scotland) Act 1980; Schedule 4; Section 30(1)(a)& (b).& 30(2). & 31(1)	Water Industry Act 1991; Section 73 & 75
Secondary legislation – Public Water Supplies – Drinking Water Quality	The Water Supply (Water Quality) Regulations 2000 (as amended)	The Water Supply (Water Quality) Regulations (Northern Ireland) 2007 (as amended)	The Public Water Supplies (Scotland) Regulations 2014	The Water Supply (Water Quality) Regulations 2010
Secondary legislation – Public Water Supplies – Water Fittings	The Water Supply (Water Fittings) Regulations 1999 (as amended)	The Water Supply (Water Fittings) Regulations (Northern Ireland) 2009	The Water Supply (Water Fittings) (Scotland) Byelaws 2014	The Water Supply (Water Fittings) Regulations 1999 (as amended)
Secondary legislation – Private Water Supplies	The Private Water Supplies Regulations 2009 (as amended)	The Private Water Supplies Regulations (Northern Ireland) 2009 (as amended)	The Private Water Supplies (Scotland) Regulations 2006 and amended by The Water Quality (Scotland) Regulations 2010	The Private Water Supplies (Wales) Regulations 2010 (as amended)

The secondary legislation transposes into law the European Union Council Directive 98/83/EC on the quality of water intended for human consumption. Compliance with this Directive is the responsibility of the UK legislators (as a member state) with Defra providing representation as the regulatory authority.

[Water Supply \(Water Fittings\) Regulations 1999](#) have been amended by:

- [The Water Supply \(Water Fittings\) \(Amendment\) Regulations 1999 – SI 1506/1999](#)
- [The Water Act 2003 \(Consequential and Supplementary Provisions\) Regulations 2005 – SI 2035/2005](#)
- [The Construction Products Regulations 2013 – SI 1387/2013](#)

Regulators' specifications and Defra guidance

Defra Guidance (previously DETR)	Guidance
WC Suite Performance Specifications	Specification
Regulator's specification for backflow prevention arrangements and devices	Specification
Specification for the performance of water fittings	Specifications (WRAS website)
DEFRA – Archived Water Index website home to Specifications & Guidance	Website

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