

# **Procedural Document**

**For the management and control of Legionella including  
“safe” hot water, cold water and drinking water**

## **Chapter 2: Design and Handover of Water Systems**

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## REVISIONS

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# **1 System/plant design, installation and maintenance**

## **1.1 General design and installation considerations**

Designers must refer to the UWE Design Guides before commencing any design work.

Systems which utilise or contain water and can affect the water supply, the atmosphere and the user shall be monitored regularly and be subjected to the following regime:

- All designs must be carried out and presented in accordance with all relevant and current Guidelines, European and British Standards and “best-practices”.
- The systems shall be carefully designed to eliminate or minimise aerosol production and excessive water retention. They must also be designed to be readily drained and cleaned.
- No materials used in construction shall include those that are known to harbour or provide nutrient for bacteria.
- Any materials that come into contact with the water in a hot or cold water installation shall comply with the requirements of the Water Supply (Water Fittings) Regulations 1999. The list of products/materials that have been assessed for compliance with the Water Supply (Water Fittings) Regulations 1999 requirements are listed in the current edition of Water Fittings and Materials Directory that is updated every six months. Further information on the selection of materials can be found in BS8558 and BS6920.
- Some flexible hoses are unsuitable for use with domestic potable water, because they support extensive microbial growth, give the water a very strong, unpleasant, taste and odour or release toxic substances into it. Hose materials may also encourage the growth of Legionella bacteria. It is, therefore, UWE’s policy that in new buildings or refurbishments commissioned by or on behalf of UWE, flexible hoses shall be avoided where possible. Any flexible hoses fitted shall be WRAS approved. Enquiries regarding specific types of flexible hose shall be directed to the manufacturer/supplier.
- All systems must be easily and safely accessible for maintenance.
- All systems/outlets shall be designed, wherever possible, to be frequently used to avoid stagnant water which will increase the potential of bacterial growth and proliferation.
- All plant and distribution pipe-work (where accessible) shall be clearly labelled.

## **1.2 Cold water storage tanks**

- Cold water storage tanks shall be constructed from non-deleterious materials which must be WRAS approved.
- Cold water storage tanks shall be designed and installed in accordance with the current Water Supply (Water Fittings) Regulations 1999 and installed in appropriate and suitable locations to allow easy and safe access to facilitate inspection and maintenance.
- Sectional Cold Water Storage tanks shall be designed with external assembly flanges

and self-draining profiles, to facilitate easy cleaning of internal surfaces.

- Externally located cold water storage tanks shall be suitably protected from environmental conditions for all new buildings and, where practicable, for existing installations if elevated temperature is found to be due to high ambient temperatures.
- Cold water storage tanks shall be protected from the ingress of light, insects and birds.
- Cold water storage tanks shall be sized and arranged to minimise retention time of stored water (24hrs maximum), and therefore to increase the rate of stored water exchange.
- Projects should question the presence of any existing tank and consider its removal if the services it supplies can be, equally well, supplied by converting the systems to domestic Mains fed only.
- When water temperatures are found to be persistently outside recommended parameters, each unit shall be subjected to a "drop-test" designed to ascertain the capacity and demand requirements of each system, in order to ensure that excessive volumes of water are not unnecessarily stored. Eliminating storage within a system would also allow the negation of the necessary PPM Programme tasks and their replacement with much less onerous, more infrequent and less costly tasks to be carried out.
- All associated pipework and valves shall be adequately insulated and clearly labelled to identify their purpose.
- Delayed-action ball valves shall be fitted (where practicable) in order to help avoid stagnation of water.
- In new buildings where cold water storage tanks are linked "in parallel", the feed to each tank shall be fitted with a water meter in order to allow for confirmation of equal and uniform usage from all tanks in the configuration.
- Various arrangements of pumping systems are indicated in BS8558. Where booster pumps are to be installed, a break cistern will be required between the mains supply pipe and the pumps. This is required in order to comply with the Water Supply (Water Fittings) Regulations 1999 with regard to prevention of backflow. Control of the pump(s) should be fully automatic in operation and controlled by pressure sensors. Where two or more pumps are installed, the design flow should be achieved with one pump stationary (or out of service). Automatic control should be provided to cyclically and sequentially control all pumps to ensure that each is regularly brought into service. If this is not possible, documented procedures shall be in place to ensure equal usage is achieved.
- Designs should maintain stored water at a temperature of  $<20^{\circ}\text{C}$  (or no more than  $2^{\circ}\text{C}$  greater than the inlet supply temperature to the building).
- Where indicated and when it is deemed necessary and practicable, Cold Water Storage Tanks shall be upgraded, refurbished, modified or replaced so that they may comply with current Water Supply (Water Fittings) Regulations 1999. Following these works, each tank shall be cleaned and disinfected in accordance with [BS 8558:2011](#) and L8 prior to it being allowed back into service.

### 1.3 Hot water calorifiers

- Calorifiers shall be installed in appropriate and suitable locations to allow easy and safe

access to facilitate inspection and maintenance.

- Where more than one Calorifier or heating device is used, they shall 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.
- In all new installations, the combined storage capacity and heater output must be sufficient to ensure that the outflow temperature, at continuous design flow (at least 20 minutes) from calorifiers or other heaters, shall not be less than 60°C. 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 must ensure that these temperatures are achieved.
- Warm water must be prevented from entering the cold-feed. A check valve shall be provided in the cold feed, as close to the calorifier as practicable, to prevent this. However, the installation of such a check valve shall not be carried out in systems that use the cold feed for expansion. In these cases, U-bend or S-bend shall be installed in the cold-feed, sufficient distance from the connection to the calorifier, so that water which is warm is not displaced (on heating up) beyond the bend and the vertical pipe rise.
- Where practicable, all pressurisation/expansion vessels shall be of the flow- through type. Where pressurisation vessels are of the single entry type they must be fitted with appropriate flow-through valves or drain valves to facilitate flushing of the unit.
- The practice of terminating the air vent over the Water Storage Tank shall be outlawed. The vent shall be arranged to discharge over a separate tun-dish arrangement, with visible Type A air gap, sited at a level that takes account of the hydrostatic head of the system. The calorifier or water heater shall be provided with a suitable safety valve of appropriate size and vacuum release arrangement.
- Where water quality indicates the need, cathodic protection from galvanic action by means of sacrificial anodes shall be provided.
- Calorifiers shall be fitted with a de-stratification pump, where deemed necessary by monitoring and/or risk assessment, in order to avoid temperature stratification of the stored water. Some semi-storage/high-efficiency Calorifiers are supplied with an integral pump that circulates water in the Calorifier. De-stratification pumps shall not be fitted to this type of unit.
- A single circulating pump shall normally be installed in the return. If, for reasons of reliability, two pumps are installed in parallel they shall be arranged to have individual non-return and service valves and be controlled such that each one is brought into operation twice a day.
- When Calorifiers are isolated from the system (for whatever reason), the associated distribution system shall be subjected to DAILY flushing. However, this is only necessary when the Calorifier isolated is the sole supply of Hot Water Services (HWS) to that distribution system. Where more than one Calorifier supplies the distribution services, the isolated calorifier shall be drained down and remain drained whilst off line.
- A suitably sized drain shall be connected to the base of each calorifier (where practicable).
- Calorifiers shall be maintained at the following temperature profiles at all times:
  - "Stored" and "Flow" at  $\geq 60.0^{\circ}\text{C}$

- "Return" at  $\geq 50^{\circ}\text{C}$  - "Return" temperatures must be measured from each "Return" leg
- "Distribution" at  $\geq 50^{\circ}\text{C}$
- "Drain" at  $\geq 50^{\circ}\text{C}$

In order to ensure that the temperatures required to achieve thermal disinfection ( $>60^{\circ}\text{C}$  for the "Flow" and  $>50^{\circ}\text{C}$  for "Distribution") are maintained, it is important to ensure that the Calorifiers should be allowed to operate continuously ensuring that the heat source is available constantly. Where the Primary Heating Source is not set by a timer, the heating source shall be left 'on' at all times.

- Where Calorifiers are to be operated on a timed basis, the cylinder and recirculating system (where fitted) shall be held at  $\geq 60^{\circ}\text{C}$  for one hour per day. Shunt pumps may require fitting to ensure the cylinder can comply with this temperature. The reduction in overnight temperature shall also be considered in the risk assessment and any recommendations for increased monitoring shall be instituted. Proof of system compliance will be required to be provided which shall include monitoring for Legionella 6 monthly on each system and an annual verification of the pasteurisation regime. If Legionella levels cannot be controlled to within expected levels by this regime, an additional control regime (such as chlorine dioxide) will be required to enable timer use.
- Calorifiers shall be subjected to regular manual check for "Flow" and "Return" temperature to each vessel and return temperature from each return leg. BMS may only be used as the monitoring device where all points required to be taken are fitted with BMS sensors and the sensor has been calibrated within the last 12 months, otherwise manual monitoring will be required.
- Where practicable Calorifiers shall have water softening devices fitted where water is stored over  $60^{\circ}\text{C}$  to prevent scaling and degradation of the calorifiers. Softening systems shall only be allowed to be fitted with the approval of the Compliance Manager.
- Cleaning, flushing and pasteurisation shall be carried out in the event of major modifications or after a period out of service, before a Calorifier is returned to service.
- Where temperatures in the calorifier and/or recirculating system are reduced to below  $48^{\circ}\text{C}$  due to temporary shutdowns (including holiday shutdowns) or system failure for a duration of more than 30 days, the calorifier shall be drained and refilled, then system shall be pasteurised for one hour before being allowed back "on-line". All outlets, drains and dead legs shall be flushed during the pasteurisation period for at least 5 minutes achieving a temperature of  $\geq 60^{\circ}\text{C}$ .
- Where temperatures in the recirculating system are reduced to below  $48^{\circ}\text{C}$  due to temporary shutdowns (including holiday shutdowns) or system failure for a duration of less than 30 days, the system shall be pasteurised for one hour before being allowed back "on-line". All outlets, drains and dead legs shall be flushed during the pasteurisation period for at least 5 minutes achieving a temperature of  $\geq 60^{\circ}\text{C}$ .
- Return and shunt pumps shall be overhauled on an annual basis (where this is a stated requirement) or shall be serviced and maintained to manufacturers specifications.
- Cistern-type water heaters shall be maintained such that the cold tank part of the heater is kept clean and at the correct temperature, and the hot tank part maintained at a

temperature of >60.0oC allowing for distribution temperatures of >50.0oC. A screened vent and an insect/rodent overflow screen shall be fitted to the tank part of the units.

- Instant water heaters (<5litres), including combination boilers, usually store small water volumes, and because of this they do not usually need to be operated within the temperature profile and limits prescribed for larger systems ( $\geq 60^{\circ}\text{C}$  for the 'flow' and  $\geq 50^{\circ}\text{C}$  for the 'return' and 'outlet') which are necessary for thermal disinfection. It is UWE policy to operate these units to achieve an outlet temperature of  $\geq 50^{\circ}\text{C}$ . They should however be switched on at all times to ensure and encourage adequate use.

## 1.4 Hot water and cold water distribution systems

- The design and installation of the hot and cold water distribution system shall comply with the Water Supply (Water Fittings) Regulations 1999 and [BS 8558:2011](#).
- The design of the pipework shall ensure that there is no possibility of a cross-connection between installations conveying potable water and an installation containing non-potable water or water supplied from a private source (untreated). There shall be no possibility of backflow towards the source of supply from any tank, cistern or appliance, whether by back siphonage or otherwise.
- All cold distribution pipework, mains and tank down feeds shall be located, as far as is practicable, to minimise heat gains from their environment. Pipework shall not be routed through hot ducts or run adjacent to heat sources, such as radiators.
- All pipework shall be insulated, except for any exposed final connections to facilities, and shall be arranged to eliminate or minimise dead-legs.
- As far as possible, the objective shall be to design the cold water systems to ensure that the inlet, outlet and surface water temperatures of cold water storage tanks are not greater than  $2^{\circ}\text{C}$  above that measured at the main water meter. Also, at cold water draw-off points, a temperature of not greater than  $2^{\circ}\text{C}$  above the temperature measured in the source Cold water storage tanks shall be reached within one minute.
- Stagnation shall be avoided. Hot and cold water services shall be sized to provide sufficient flow at draw-off points. The aim is to promote turnover of water by means of; the design of the distribution circuitry, adequate usage and avoidance of "disused" areas.
- Where practicable; separate drinking water systems shall be provided directly from the incoming water supply to each building without storage, with stored cold water (down service) being used solely for supplies to WCs, wash hand basins, etc. The supply shall not be chemically softened. Additionally, it shall be established that the usage is sufficient to avoid deterioration in water quality, for example, that the outlet water temperature does not exceed  $20^{\circ}\text{C}$  and that the outlet remains in use. Where drinking water is stored, the tanks shall conform to WRAS and BS8558 guidance for drinking water storage systems. Wherever drinking water is stored, a "post-flush" TVCC sample will be required to be taken from a designated drinking water outlet from each system on a 6 monthly basis.
- The water supply to vending and ice making equipment shall be taken from a potable supply up stream of a regularly used outlet with the minimum of intervening pipe run i.e. less than 3 metres. The supply shall not be Chemically softened. Additionally, it shall

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 and that the outlet does not remain unused.

- The equipment shall be positioned so that the warm air exhaust does not impinge directly on taps or hoses supplying cold water.
- The domestic hot water system shall not be used for heating purposes. This includes all radiators, towel rails, heated bedpan racks etc, whatever the pipework configuration.
- Central “common blending” systems shall not be installed, since the length of distribution pipework containing water in the temperature range that supports bacterial growth and proliferation would far exceed the maximum permissible lengths mentioned above. Where already fitted with a run of more than 2 metres between the mixer and outlet, they shall be subjected to a weekly flush of all outlets.
- Designated drinking water systems and outlets shall be designed to be maintained within 2°C of incoming mains water temperature.
- Projects shall allow for isolating the unused sections from the system and possibly removing pipe-work and fixtures completely to avoid “dead-legs”
- It is UWE’s policy not to fit hose-reels and to decommission existing reels at the earliest opportunity.

## **1.5 Showers baths and thermostatic mixing valves/taps (TMV/TMT)**

- At outlets fitted with TMVs/TMTs, the temperature shall be designed to achieve:
  - 41oC for showers
  - 41oC for basins
  - 38oC for bidets
  - 44oC for baths
- The pipe-work length from TMV to the outlet shall be restricted to a maximum of 2m.
- All TMVs/TMTs shall be fitted with strainers, isolation valves and non-return valves.
- All TMVs shall be accessible.
- Central “common blending” shower-block systems shall not be installed and all pipe-work length from the TMV to the shower-head shall be restricted to a maximum of 2m.
- Where “common blending” shower-block systems are already in place, each system shall be fitted with a solenoid valve (at the furthest point from the mixer valve), programmed to automatically purge water for a three minute period each day. Additional monitoring of these systems may be required as deemed necessary by risk assessment.

## **1.6 Expansion/pressurisation vessels**

- All new and replacement expansion/pressurisation vessels fitted shall be of the “flow-through” type.
- Expansion vessels shall be located on the cold feed rather than on the hot water side of the system. The length of pipework between the expansion vessel and cold feed shall be



as short as practicable, e.g. less than 1 metre.

- All existing expansion vessels of the single entry type must be fitted with appropriate flow-through valves or drain valves to facilitate flushing of the unit. If fitted with a drain, this drain must be flushed on a weekly basis.

## **1.7 Usage evaluation**

Designers shall undertake 'usage evaluation' of the following and shall specify weekly flushing (or manual or automatic flushing of the supply pipes using bleed valves) if the usage is found to be infrequent:

- De-ionisers
- Dishwashers/washing machines.
- Injection moulding machines (total water loss).
- Indoor, ornamental water features

## **1.8 Prohibited features**

- Lathes or CNC machines using organic cutting oils
- Portable "wet" evaporative cooling point-of-use units

## **1.9 Greywater systems**

Greywater systems shall comply with BS 8525-1:2010 - Greywater systems – Part 1: Code of practice and BS 8525-2:2011 - Greywater systems –Part 2: Domestic greywater treatment equipment – Requirements and test methods.

## **1.10 Temporary water supplies**

- UWE, or others on its behalf, when providing and managing temporary water supplies, shall comply with their duties under the Health and Safety at Work etc. Act and BS 8551:2011 - Provision and management of temporary water supplies (not including provisions for statutory emergencies).

## **1.11 Irrigation systems**

- Irrigation systems shall only use treated water (or treated grey water) and water shall not be dispersed using sprays.

## **1.12 Ice making machines**

- Ice is defined as food under the Food Safety Act 1990 and must be made, stored and handled so that it is not contaminated, a requirement of the Food Safety (General Food Hygiene) Regulations 1995.

- In order to control the potential of microbiological and other contamination, the following actions shall be considered and implemented:
  - Connect the machine directly to the drinking water supply, ensuring that the supply pipework is as short as possible and insulated from passive heat gain, particularly in locations where the supply pipework is directly next to the cooling fan.
  - Site the machine in a clean room, away from sources of contamination such as human waste (in sluice rooms) and cleaning chemicals.

### **1.13 Outdoor ornamental fountains and water features**

For ornamental features in public settings, designs should prevent public bathing.

### **1.14 Humidified food cabinets**

- Designs to comply with established best practice.

### **1.15 Ion exchange water softeners**

- Designs to comply with established best practice.

### **1.16 Portable humidifiers**

Portable humidifiers shall not be used without the written permission of the Compliance Manager who would need to ascertain suitability of use following an adequate risk assessment.

## **2 Training at handover**

Where necessary, training shall be provided at handover. This should be extended beyond Estates to facilities colleagues and will include staff involved in using ice making machines, humidified food cabinets etc.

## 3 Handover documentation

### 3.1 Domestic water services

<b>Process No.</b>	2.1
<b>Task</b>	Building handover protocol from build contractor to UWE for new buildings and major refurbishments
<b>System</b>	Domestic water services
<b>Requirements Prior to Handover (action by main contractor)</b>	
Cleaning and Disinfection:  BS 8558.	<p>The system once totally complete is to be cleaned and disinfected. This process is to include:</p> <ul style="list-style-type: none"> <li>• Mains cold water services</li> <li>• Stored cold water services</li> <li>• Hot water services</li> <li>• Only spray devices – showers, spray taps etc</li> <li>• Devices that may trap debris – TMV/TMT, Filters etc</li> <li>• All individual outlets - taps</li> </ul>
Microbiological Sampling:  BS 7592. BS 8558.	<p>Following the cleaning and disinfection microbiological samples are to be taken across the system to give a representation of the potable water quality within the building. Samples are to be submitted to a UKAS laboratory for analysis.</p> <p>Samples are to be taken from the following points:</p> <ul style="list-style-type: none"> <li>• Mains cold water services (entry point and furthest extremity) - TVCC</li> <li>• Stored cold water services (closest to storage and furthest point from storage) - TVCC</li> <li>• Hot water services (each hot water generator and furthest point from generator) – TVCC and Legionella</li> </ul> <p>TVCC:</p> <ul style="list-style-type: none"> <li>• Total viable count at 22°C</li> <li>• Total viable count at 37°C</li> <li>• Coliforms</li> <li>• E.Coli</li> </ul>
Temperature Profile :  L8. HSG274 Part 2.	<p>Water temperatures are to be recorded 3 times equally spaced over 24 hours following the commissioning of the system.</p> <p>Temperatures to be achieved:</p> <ul style="list-style-type: none"> <li>• Stored cold water - &lt;20 °C after 2 minutes of running</li> <li>• Cold water distribution (furthest point) - &lt;20 °C after 2 minutes of running</li> <li>• Hot water generator – min 60 °C</li> <li>• Return to hot water generator - &gt; 50 °C</li> <li>• Hot water distribution (nearest and furthest points from hot water generator) - &gt; 50 °C after 1 minute of running)</li> </ul>
Flushing:  L8. HSG274 Part 2.	<p>Where a time period of longer than 1 week occurs between the cleaning and disinfection process and handover to UWE a programme of weekly flushing is to be undertaken.</p> <p>A sequential process of flushing each outlet is to be carried out.</p> <p>Flush the outlets until the temperature at the outlet stabilises and is comparable to supply water and purge to drain.</p>
<b>Requirements Post Handover – within 2 weeks (action by UWE legionella consultant)</b>	
Legionella risk assessment:  L8	<p>A legionella risk assessment is to be carried out to assess the risk from the legionella organism.</p> <p>The assessment is to be carried out once building occupancy levels have reached “normal” operating conditions.</p>

Handover documentation record			
Building Name			
Handover date			
Documents	Yes	No	N/A
Schematics			
Cleaning and disinfection certificate			
UKAS microbiological certificates			
Temperature profile			
Flushing records			
WRAS certification			

## 3.2 Process water systems

<b>Process Number</b>	2.2
<b>Task</b>	Building handover protocol from build contractor to UWE for new buildings and major refurbishments
<b>System</b>	Process water systems
<b>Requirements Prior to Handover (action by main contractor)</b>	
Cleaning and Disinfection: <ul style="list-style-type: none"> <li>Design guide for specific system</li> <li>HSG274 Part 3</li> </ul>	The system once totally complete is to be cleaned and disinfected. This process is to include: <ul style="list-style-type: none"> <li>Storage device within system</li> <li>Cold water distribution</li> <li>Hot water distribution</li> <li>Spray devices</li> <li>Devices that may trap debris – Filters etc</li> <li>All individual outlets</li> </ul>
Microbiological Sampling: <ul style="list-style-type: none"> <li>BS 7592.</li> <li>BS 8558.</li> </ul>	Following the cleaning and disinfection microbiological samples are to be taken across the system to give a representation of the water quality. Samples are to be submitted to a UKAS laboratory for analysis. Samples are to be taken from the following points: <ul style="list-style-type: none"> <li>Mains cold water services feeding the system - TVCC</li> <li>Stored cold water services (closest to storage and furthest point from storage) - TVCC</li> <li>Hot water services (each hot water generator and furthest point from generator) – TVCC and Legionella</li> <li>Spray outlet - Legionella</li> </ul> TVCC: <ul style="list-style-type: none"> <li>Total viable count at 22°C</li> <li>Total viable count at 37°C</li> <li>Coliforms</li> <li>E.Coli</li> </ul>
Flushing: <ul style="list-style-type: none"> <li>L8.</li> <li>HSG274 Part 3.</li> </ul>	Where a time period of longer than 1 week occurs between the cleaning and disinfection process and handover to UWE a programme of weekly flushing is to be undertaken. A sequential process of flushing each outlet is to be carried out. Flush the outlets until the temperature at the outlet stabilises and is comparable to supply water and purge to drain.
<b>Post Handover – within 2 weeks (action by UWE legionella consultant)</b>	
Legionella risk assessment  L8	A legionella risk assessment is to be carried out to assess the risk from the legionella organism. The assessment is to be carried out once building occupancy levels have reached “normal” operating conditions.

Handover documentation record			
Building			
Handover date			
Documents	Yes	No	N/A
Schematics			
Cleaning and disinfection certificate			
UKAS microbiological certificates			
Flushing records			
WRAS certification			

### 3.3 Closed heating and cooling circuits

<b>Process Number</b>	2.3
<b>Task</b>	Building handover protocol from build contractor to UWE for new buildings and major refurbishments
<b>System</b>	Heating and cooling closed circuit systems
<b>Requirements Prior to Handover (action by main contractor)</b>	
<b>Pre-Commission cleaning:</b> <ul style="list-style-type: none"> <li>BSRIA Pre-Commission Cleaning of Pipework Systems BG29</li> <li>BG50 Water Treatment for Closed Heating and Cooling Systems</li> </ul>	The system once totally complete is to be pre-commission cleaned in accordance with BSRIA standards.
<b>Microbiological and chemical sampling:</b> <ul style="list-style-type: none"> <li>BSRIA Pre-Commission Cleaning of Pipework Systems BG29</li> <li>BG50 Water Treatment for Closed Heating and Cooling Systems</li> </ul>	On completion of the pre-commission cleaned the system is to be sampled in accordance with BSRIA standards. The samples are to be submitted to a UKAS accredited laboratory.

<b>Handover documentation record</b>			
Name of Building			
Handover date			
Documents	Yes	No	N/A
Schematics			
Pre-commission cleaning certificate			
UKAS microbiological and chemical certificates			