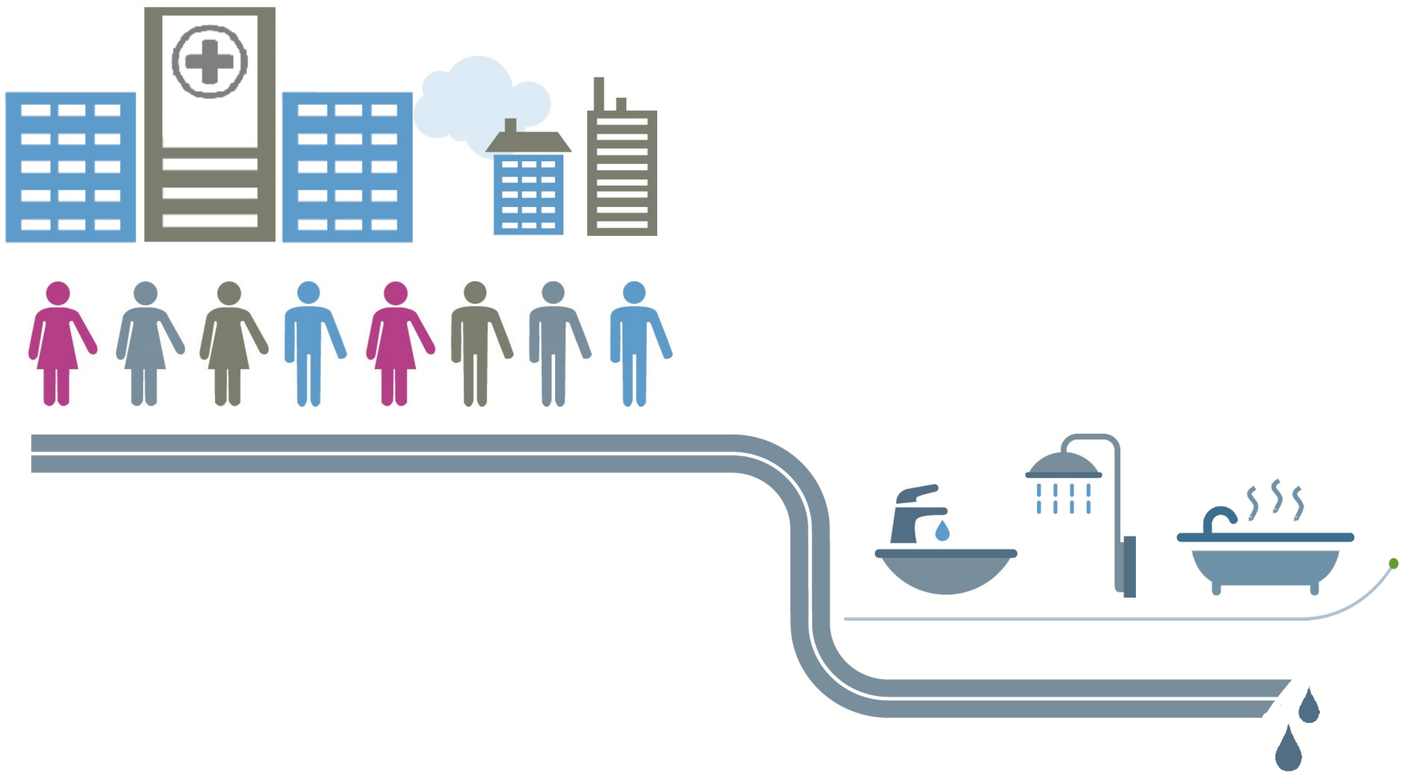
beama Water Safety & Hygiene

RECOMMENDED CODE OF PRACTICE FOR SAFE WATER TEMPERATURES



February 2020

OVERVIEW

This document replaces the previous Recommended Code of Practice for Safe Water Temperatures published back in March 2000 which has now been withdrawn.
The original Code of Practice was developed by manufacturers through the Thermostatic Mixing Valve Manufacturers Association (TMVA). Over time the TMVA has evolved into the 'Water Safety and Hygiene group' within BEAMA and its scope has expanded to cover a wider range of valves and other products. Its focus is now to deliver safe hot water solutions on a systems-based approach as well as at point of discharge.

Whilst this document is primarily concerned with non-domestic installations, the guidance given is equally appropriate in domestic situations.
The Water Safety and Hygiene group is made up of many of the leading manufacturers of safe, hygienic and economic products for use in buildings from water supply and storage through distribution systems up to and including the point of discharge. The group members collectively and continuously strive to address all issues concerned with the full range of products they supply to all market sectors. This includes but is not limited to: Healthcare, Education, Sport, Leisure, Military and Commercial properties. One of the group's key aims is to concentrate attention on the safe provision of hot water at the point of use. Thermostatic Mixing Valves (TMVs) remain a major activity area for all group members and the breadth of knowledge and expertise available through this group has contributed to this authoritative and informative Code of Practice.

This document is intended to give clear guidance on how to deliver hot water safely but does not supersede any current legislation or standards. The guidance given in this document is particularly relevant for all non-domestic installations, including but not limited to:

- Healthcare Premises
- Care homes
- Schools
- Hotels
- Sports & Leisure Facilities

The scope of this document is to make sure that everybody engaged with the selection, design, installation, operation and maintenance of wholesome hot water systems fully understands the correct selection, operation and use criteria for TMVs. This document will cover this in detail in terms of:

a) Safety – Prevention of Scalding

b) Hygiene – Infection Control

c) Compliance – Quality of product

In addition to the industry expertise, this document uses information from a wide range of reference publications and is accurate to the best knowledge of the members of the Water Safety and Hygiene group.

Any reader of this Code of Practice requiring further information on any aspect of this guidance, or on any other aspect relating to TMVs or other water valves should visit the Water Safety and Hygiene area of the BEAMA website : www.beama.org.uk (Reference 41 in Appendix A).

CONTENTS

INTRODUCTION

This Code of Practice document has been prepared by the members of the BEAMA Water Safety and Hygiene group for use by building managers, consulting engineers, installers, facilities managers and any other interested parties

The majority of occupied buildings in the UK are served by hot water storage and distribution systems. Where a building is being used by people other than the owner of the building (third parties), the owner (or manager) of the building has a duty of care to ensure that others can use the building and its facilities safely.

The role of the Building Services professional is important in ensuring that hot water and storage systems are designed, installed, serviced and maintained correctly so that risks from scalding or bacterial infection are reduced to an absolute minimum. Despite this, every year in the UK a significant number of building occupants are injured or die because of these risks. This is ably demonstrated by the NHS England figures shown in Table 1 below for hot water tap injuries. This shows that despite all the industry led information and support available, scalding injuries are increasing.

TABLE 1: HOT TAP - WATER INJURIES 2009 - 2018 NHS ENGLAND

	2009-10	2010-11	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18
Finished Consultant Episodes (FCE)	655	719	693	587	575	672	729	713	755
Finished Admissions Episodes (FCA)	643	709	687	577	561	661	718	697	736
Male	336	357	369	305	285	346	383	370	422
Female	319	362	324	282	290	326	346	343	333
Emergency	499	557	562	466	467	537	586	588	621
Age 0-14	381	413	375	308	254	316	337	331	331
Age 15-59	152	187	174	153	172	179	215	220	232
Age 60-74	45	45	61	51	65	70	67	60	86
Age 75+	74	73	82	74	83	106	106	97	102
Mean length of stay	5	5	5	5	6	6	5	5	5
Median length of stay	1	1	1	1	2	1	1	1	1
Day case	7	4	10	13	22	42	27	38	31
FCE bed days	3,226	2,976	2,963	2,938	3,194	3,444	3,539	3,126	4,055

Source: NHS England (https://digital.nhs.uk/data-and-information/publications/statistical/hospital-admitted-patient-care-activity)

All these injuries are wholly preventable by the correct installation and use of appropriate and well-maintained safety products. This is further endorsed by the National Health Service classifying scalding as a 'Never Event' (Never events are serious incidents within healthcare establishments that are wholly preventable because guidance or safety recommendations that provide strong systemic protective barriers are available at a national level and should have been implemented by all healthcare providers – Reference document 33 in Appendix A).

The best way to prevent scalding is to install and maintain Thermostatic Mixing Valves (TMVs). A TMV is designed to accurately control water temperatures for baths, showers, hand-wash basins and bidets. They are designed to maintain the desired water temperature, even when the incoming water pressures and/or flow rates change. By contrast, a mechanical mixing valve cannot adjust to changes in supply temperature, pressure or flow rate.

Hot and cold water entering the TMV is mixed to a pre-selected 'safe' temperature. This is achieved automatically by a thermally sensitive mechanism within the valve that proportions the amount of hot and cold water entering to produce the required blended temperature. The mechanism then automatically compensates for any variations in supply pressures or temperatures to maintain the pre-selected temperature. In the event of cold-water supply failure, the thermostatic mixing mechanism will automatically shut down the flow to prevent discharge of dangerously hot water.

It is important to establish and understand that TMVs are not devices designed to counter legionella. The key fact to be understood is that maintaining a high temperature hot water distribution system is how the legionella risk is managed and TMVs are simply the means by which the water temperature is reduced for comfort and safety of the end user at the point of use.

Thermostatic Mixing Valves are designed, constructed and tested to meet specific industry standards and their design performance should be appropriate to the application (Reference document 40 in Appendix A).

Low risk applications can be described as applications in general purpose areas, such as wash rooms, where users are not deemed to be at risk. If there is any doubt, a risk assessment procedure should be carried out.

High-risk applications are primarily within the healthcare and care homes sector and in any other application where the user is deemed to be at risk. Typically, those most at risk are children, older people and people who are mentally or physically impaired.

A summary of the benefits of installing TMVs is shown below for reference:

- By limiting water temperature and stopping sudden increases in water temperature, TMVs help to prevent scalding, which can cause very serious and even fatal injuries.
- In healthcare, the use of TMVs is a vital part of ensuring the safety of patients and staff from the dangers associated with scalding from distributed hot water systems operating at around 60°C.
- The NHS in England, Northern Ireland, Scotland and Wales all endorse the health guidance note that recommends TMVs as a way to help health employers meet their duty of care (Reference document 34 in Appendix A).
- MV3-approved valves are certified against the requirements of the NHS Estates document D08 (Reference document 27 in Appendix A) , which covers mixing valves installed within healthcare properties.
- In the event of cold-water supply failure, the thermostatic mixing mechanism will automatically shut down the flow to prevent discharge of dangerously hot water. The flow will also be shut down in the event of a hot water supply failure to prevent thermal shock.
- Digital thermostatic mixing valves control water temperature and flow by means of accurate temperature measurement and electrical/electronic control. As with all TMVs they can comply with TMV2 and TMV3 approval schemes and maintain the same level of thermostatic control (Reference 40 in Appendix A).
- Digital products can utilise manual or touch free control by the user, the latter providing a degree of infection control for surface transmitted infections. The digital nature of these products can also provide additional duty flushing or thermal disinfection regimes, programmed by facilities management personnel.
- It is increasingly common practice around the world to regulate the storage water temperature to at or above 60°C, and to circulate water at a temperature at or above 55°C. Installing TMVs can ensure that water is delivered at the required temperature at point of use, thereby reducing the risk of scalding accidents, it also reduces hot water consumption from a supply that is maintained at a higher temperature.
- TMVs are an important method of facilitating regular and effective clinical hand-washing by staff in healthcare settings through the provision of increased comfort, safety and convenience. Regular and effective hand-washing by healthcare staff is of critical significance in the battle against hospital-acquired infections. Hand-washing is the single-most effective way to prevent hospital-associated infections.

1
HISTORY

At the beginning of the twentieth century, water was traditionally heated by a steam boiler and was typically stored at 60°C in a calorifier. Hot water was delivered at 60°C for kitchen or laundry uses and blended down to a usable temperature for sanitary and other purposes. This was done through an earlier version of the current TMV, which was centrally located near the calorifier in the plant room. Crucially, TMVs were then located at the plant room, rather than at the point of discharge, and water for sanitary purposes used to be distributed at temperatures of approximately 40°C. The earlier versions of the TMV would have had fewer mechanical features than modern TMVs and would not have met the demanding safety, quality and performance standards required of current TMVs.

It is important that it is understood that thermostatically controlled warm water has been supplied to hospital taps and ablutionary outlets since the late 1920's and so it is difficult to quantify what the full implications might be of reverting to an earlier era whereby staff users presumably had to use manual mixer devices which would have discharged water at an unpredictable, inconsistent and varying temperature.

The discovery of Legionella in the mid-1970s prompted TMVs to be moved toward the point of use to make the majority of the domestic hot water circuit inhospitable and avoid legionella taking up residence in the hot water distribution pipework (by raising the distribution temperature to 55-60°C).

Distributing hot water at higher temperature has proved to be an effective means of controlling legionella proliferation in hot water systems. Over time, manufacturers have worked closely with the hospital engineers to develop modern TMVs fit for point-of-use blending. This helped meet the needs of the NHS in preventing scalding and allows the NHS to implement their preferred method of controlling legionella through high temperature water distribution.

In the 1980s, most systems moved from centralized blending to point-of-use blending. It is important to understand that the term 'TMV' also includes showers and taps with built-in TMVs as this point is often not fully recognised.

Over the last 20 years TMV manufacturers have led the way in developing TMV quality and performance standards and have also helped to develop a certification scheme that ensures that only good quality products that perform correctly are available to the healthcare sector and beyond. This 'TMV3 scheme' is independently administered by NSF International (formerly known as Buildcert) and provides a register of products which have been tested to ensure they adhere to the quality and performance standards required (Reference 40 in Appendix A).

2
SAFETY

There are two areas of risk to personal safety covered by this document and the facts are expanded in the two following sections

2.1 Scalding from hot water from stored hot water
2.2 Legionella infection typically from stored hot water

Both these areas of risk arise from the domestic hot water systems which serve the needs of building occupants. Effective measures can be used to minimise the risks for both scalding and legionella. However, in many cases the control measures needed to reduce either one of the risks increases the potential risk from the other.
i.e. On the one hand hot water temperatures that do not cause scalding are ideal for the legionella bacteria to grow in a water system, but, on the other hand, hot water temperatures that kill the legionella bacteria will cause scalding.

Evidence on scalding indicates a risk increasing rapidly from temperatures of 45 °C and above. For example, partial thickness burns will occur within 30 seconds at 55°C, reducing to less than 5 seconds at 60°C and above. These examples are taken from figures represented in the NHS Estates Health Guidance note, "SAFE' hot water and surface temperatures' (Reference document 34 in Appendix A) but these are only guideline figures. Skin sensitivities vary greatly throughout the population with older people and the very young having more fragile skin, as do the risks from high temperatures for the population with specific medical conditions.

TABLE 2: TEMPERATURE VERSUS EXPOSURE TIME

The severity of a burn will be affected by the temperature and the time of exposure to hot water:

Type of burn	Time of exposure in minutes and seconds							
Temp	45°C	50°C	55°C	60°C	65°C	70°C	75°C	80°C
Adult 3rd	>60m(e)	300s	28s	5.4s	2.0s	1.0s	0.70s	0.6s(e)
Adult 2nd	>60m(e)	165s	15s	2.8s	1.0s	0.5s	0.36s	0.3s(e)
Child 3rd	50m(e)	105s	8s	1.5s	0.52s	0.27s	0.18s	0.1s(e)
Child 2nd	30m(e)	45s	3.2s	0.7s	0.27s	0.14s	<0.1s	<0.1s(e)

(e) = estimated
This table has been taken from a 1993 ASSE paper. There are several different published figures used to indicate the effect of temperature and time on the severity of the resultant burn. All figures used must be taken as indicators only as from the difference in published figures the results will be likely to vary from person to person.

2.1 SCALDING

Scalding can occur with exposure to hot water at temperatures as low as 50°C. The degree of skin damage from scalding will depend on the hot water temperature, the volume of hot water, the immersion time and the fragility of the skin of the person in contact with the hot water. Young children and older people are more susceptible than typical adults and Table 2 below illustrates this.

2.1.1 RECOMMENDED SAFE HOT WATER TEMPERATURES

The NHS Estates Health Guidance Note (Reference document 33 in Appendix A) refers to maximum hot water and surface temperatures for safe use. These are recommended for all healthcare premises and those premises registered under the Registered Homes Act 1984 (Reference document 4 in Appendix A) but are applicable for other types of occupied building.

a) 44°C for an unassisted bath fill
b) 46°C for an assisted bath fill **
c) 41°C for shower applications
d) 41°C for washbasin applications
e) 38°C for bidet applications

** This 'high' fill temperature should only be considered in exceptional circumstances where there are difficulties in achieving an adequate bathing temperature. The building manager should also have in place specific policies that prevent the possibility of persons judged to be at risk gaining access to the bath unaccompanied.

2.2 LEGIONELLA

Legionella bacteria are naturally occurring organisms present in many water systems, and if human beings are exposed to breathable water droplets (aerosols) from the system it can lead to the development of Legionnaires' disease.

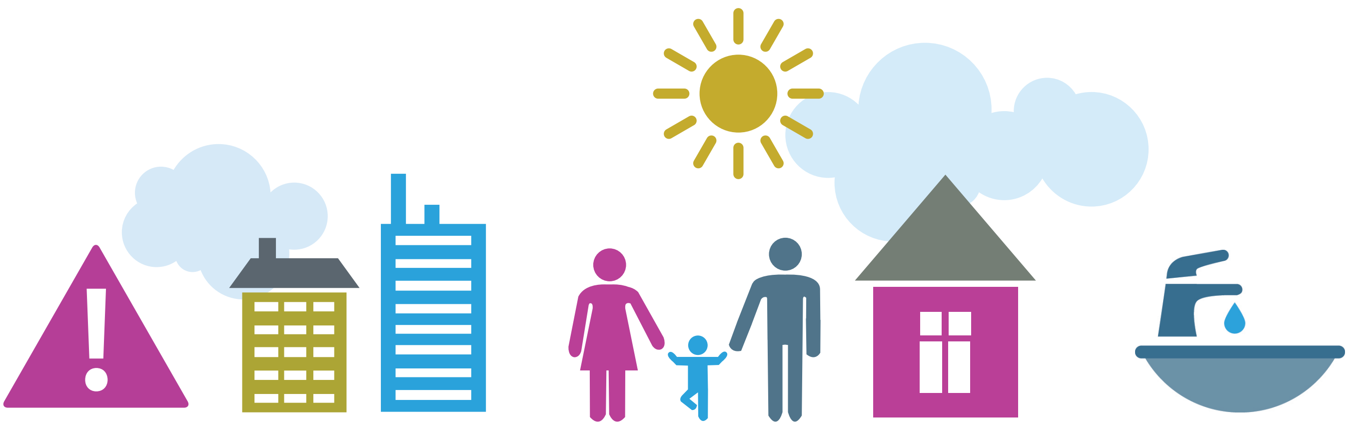
The evidence for the occurrence of Legionella in water systems varies between different reports. The WHO study 'Legionella and the prevention of legionellosis – 2007' (Reference document 38 in Appendix A) provides detailed information and includes the following information:

- Legionella bacteria will die at temperatures maintained at or above 60°C with pasteurisation occurring at 70 °C and above.
- Legionella bacteria survive and multiply between 25°C and 45°C with the optimal temperature range for growth between 32 °C and 42 °C.
- Legionella bacteria will not multiply at temperatures below 20°C but will remain dormant and viable in the system.

2.2.1 RECOMMENDED MEASURES TO CONTROL LEGIONELLA

Basically, all measures introduced need to ensure hot water is hot, cold water is cold and that distributed water should be kept clean and flowing. This can be delivered through 3 key principles:

- The water distribution system should always be maintained in a hygienic condition.
- Ensure that water supplies are distributed to the point of mixing, either below 20°C for cold water supplies or above 55°C for hot water supplies.
- Hot water should be stored at or above 60°C.



3
HYGIENE

The importance of hand-decontamination

'Handwashing is the single most important way to prevent the spread of infection' – Infection Protection Control (Reference document 42 in Appendix A).

While scalding prevention is important, the role of thermostatic control in optimising the delivery of water at a comfortable temperature is essential for effective and consistent hand washing.

In healthcare properties, nursing staff are required to wash their hands prior to and after every procedure. It is imperative that water is provided conveniently and at a comfortable temperature to ensure that hand decontamination is carried out properly. Risk assessments may deem that non-thermostatic taps could be used on wash hand basins provided there is a 'danger hot water' (or similar) sign visible at the tap location. In most situations this is likely to prevent scalding as adult able-bodied users will simply pull their hand away as water temperature gets too hot. Unfortunately, this does not take account of the negative effect in that it will prevent the user from washing their hands properly. Convenience is an essential factor that must not be overlooked when trying to implement regular hand-washing. If hand-washing is not convenient, then it will be omitted, and this leads to potential secondary contamination unlikely to be recognised by the local scalding risk assessor, however, it may lead to an increase in incidents of Healthcare Acquired Infections, which carry a greater mortality risk than the scalding risk being avoided.

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It has been found that, in developed countries, around 7% of hospital admissions result in the contraction of infections that are not related to the cause of admission. (Reference document 36 in Appendix A). Some of these infections are likely to be contracted through poor hand hygiene but this is extremely difficult to measure so risk assessments should err on the side of caution.

The World Health Organisation (WHO) has developed a global priority pathogens list (global PPL) of antibiotic-resistant bacteria (Reference document 37 in Appendix A). As part of the WHO findings, it is recognised that hygiene (and associated hand decontamination) is paramount in achieving infection prevention. The most antibiotic-resistant bacteria are located within hospitals. This report has originated upon the request of all WHO's member states, who have expressed the urgency for measures to be taken regarding antibiotic resistance.

4
COMPLIANCE

There are a number of legal requirements relating to the provision of hot water in buildings. These legal requirements vary with the type of building use. The information given in this section should be read as a recommendation by the BEAMA Water Safety and Hygiene group. Appropriate legal advice should be taken to determine specific requirements based on the particular situation.

- Where a building is being used by people other than the owner of the building (third parties) the owner (or manager) of the building has a duty of care to ensure that others can use that building and its facilities in safety.
- A risk assessment must be carried out to identify potential risks and the actions necessary to improve the situation.
- In domestic premises, common law prevails.

4.1 REGULATIONS COVERING THE OPERATION AND MAINTENANCE OF WATER SYSTEMS IN BUILDINGS

The following Regulations cover many areas of building operation and maintenance. This list is a guide and should not be read as being comprehensive.

- The Health and Safety at Work Act – 1974 (Reference document 9 in Appendix A).
- SI 2051: 1992 The Management of Health and Safety at Work Regulations (Reference document 10 in Appendix A).
- SI 1039: 1978 (NI 9) Health and Safety at Work (Northern Ireland) Order (Reference document 11 in Appendix A).
- SI 459: 1992 The Management of Health and Safety at Work Regulations (Northern Ireland) (Reference document 12 in Appendix A)
- HSE Approved Code of Practice L8 the control of legionella bacteria in water systems – 2013 (Reference document 30 in Appendix A)
- Registered Homes Act 1984 (Reference document 4 in Appendix A)
- Nursing Homes and Nursing Agencies Act (Northern Ireland) 1971 (Reference document 6 in Appendix A)
- Registered Establishments (Scotland) Act 1987 (Reference document 7 in Appendix A)
- Control of Substances Hazardous to Health Regulations 1994 (Reference document 8 in Appendix A).
- The Water Supply (Water Fittings) Regulations 1999 for England and Wales, Water Bylaws 2014 (Scotland) and Water Regulations (Northern Ireland) (Reference documents 1, 2 & 3 in Appendix A)

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If the general public uses a building, the Health and Safety Executive can carry out prosecutions in the event of personal injury. (It should be noted that failure to carry out a building owner/managers statutory duty could invalidate third party liability insurance).
Web-links to all of the above regulations and additional relevant documentation can be found in Appendix A 'References, Current Regulation, Legislation, Standards and Guidance documents'

4.2 BUILDING OCCUPANTS JUDGED TO BE AT RISK

Every building occupant or user must be considered to be at risk. The degree of risk and subsequent action should be determined by risk assessment.
'Best possible practice' has been established in the 1998 NHS Estates Health Guidance Note - "SAFE' hot water and surface temperatures', (Reference document 34 in Appendix A) which states: – "All patients, residents, visitors and staff must be presumed to be potentially at risk, but some are more vulnerable to scalding and burning than others."
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4.3 THERE IS A WIDE RANGE OF STANDARDS THAT HAVE RELEVANCE IN THIS SECTOR

- NHS Estates Model Engineering Specification D08 (Reference document 27 in Appendix A). This is for single outlet applications and is accepted as best possible practice for thermostatic mixing valve performance. There is a third-party approval scheme to this standard and all such valves are designated TMV3. These are Type 3 valves as defined in the NHS Estates Guidance document. The Water Regulations Advisory Scheme (formerly Water Byelaws Scheme) lists all approved TMV3 valves in the 'Water Fittings and Materials Directory'.
- BS 7942: 2011, Thermostatic Valves for use in care establishments (Reference document 22 in Appendix A).
- BS EN 1111 and BS EN 1287 (Reference documents 20 & 21 in Appendix A - superseding the previous BS 1415 Pt 2 1986). This is for single outlet applications. Such valves are designated as Type 2 valves in the NHS Estates Guidance document and are deemed suitable for low risk applications.

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- Group mixing and Centralised mixing valves. These are only likely to be found in older installations and there is no generally accepted performance standard for these valves. Some valves approved to D08 are suitable, because of their particular flow rate, for these applications.
- The current European Standards do not require the same level of performance as D08 so, when a valve is marked with an EN, care must be taken when reading the valves performance criteria to ensure that it is fit for purpose.
- BS EN 15092:2008 - Building valves. Inline hot water supply tempering valves. Tests and requirements (Reference document 23 in Appendix A).
- BS EN 806 – 1 to 5 Specification for design, installation, testing and maintenance of services supplying water for domestic use within buildings and their curtilages (Reference documents 14 to 18 in Appendix A).

4.4 NSF TMV3 SCHEME

NHS Estates together with TMV manufacturers co-operated to establish a Third-Party Certification scheme (TMV3 Scheme), which is now administered through NSF International (formerly Buildcert). The Scheme tests and certifies thermostatic mixing valves of enhanced thermal performance and shut off for specific applications as described in the NHS Estates Model Engineering Specification D08, (Reference document 27 in Appendix A) see also section 5.3 above.
An installed approved valve will only be regarded as continuing to satisfy the requirements of the TMV3 Scheme providing the supply conditions, commissioning and in-service test requirements are as stipulated by the manufacturers of the valve.

4.5 REQUIREMENTS OF THE WATER SUPPLY (WATER FITTINGS) REGULATIONS

These replaced the Water Byelaws and cover waste, misuse, contamination, undue consumption and erroneous measurement of water supplied by a water undertaker.
All materials in contact with water must not affect its taste, colour, wholesomeness or promote the growth of potentially harmful organisms.
The design of any installed valves must be such that crossflow cannot occur. This generally means the inclusion of check valves within the TMV installation.
The Water Regulations Advisory Scheme listing of a valve demonstrates simply that it complies with the requirements of the Water Regulations when installed as specified by any Installation Requirement Note (IRN) cited in the listing.

5
APPLICATIONS

The control of delivered hot water temperatures coupled with the control of stored and distribution hot water temperature is the key to safe hot water provision. The objectives of any such control systems are to store water at above 60°C, distribute water at 55-60°C, yet deliver water at discharge temperatures between 35-46°C.

The most effective means to achieve these objectives is to store and distribute water at high temperatures and use Thermostatic Mixing Valves (TMVs) to reduce discharge temperatures to safe levels for end users

The use of TMVs to control discharge temperatures as described in this section, is recommended by the NHS Estates for use in Health Service premises. The advice given in the Health Guidance Note (Reference document 34 in Appendix A) can be applied to all types of property.

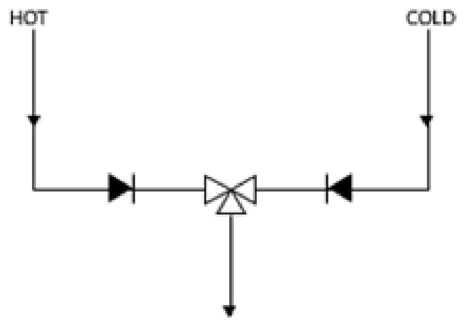
Detailed guidance in this section refers to the following areas:

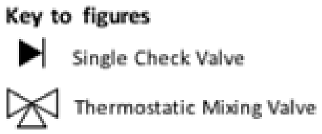
5.1 Single valve applications
5.2 Group mixing
5.3 Centralised mixing
5.4 Storage and distribution

5.1 SINGLE VALVE APPLICATIONS (Point of use mixing)

The use of a single TMV is common for a range of applications as listed below (5.1.1 to 5.1.5). The maximum pipe run recommended in these applications is 2 metres from the TMV to the outlet. The NHS Estates guidelines are based on one valve for each outlet. Back-to-back basin applications can be accepted providing the operation of one tap does not affect the performance of any other tap.

FIGURE 1: SINGLE POINT USE





The temperature of discharge should be suitable for the application as follows:

5.1.1 BATH FILL TEMPERATURES

- Normally a set temperature between 41°C and 44°C is sufficient to suit most users.
- ‘Sit in baths’, which fill when the user is already in the bath, have a lower temperature requirement depending on personal comfort levels.
- Fill temperature above 44°C in should only be considered in exceptional circumstances. (See 3.1.1)
- It should be noted that for domestic dwellings (non-healthcare), Part G of the Building Regulations (Reference document 13 in Appendix A) states that the hot water supply temperature to a bath should be limited to a maximum of 48°C

In care environments, it is often the case that for some users even normal bathing temperatures could be hazardous. When setting the maximum bathing temperature any special needs must be taken into consideration when carrying out the risk assessment.

5.1.2 SHOWER TEMPERATURES

NHS Estates states 41°C as being the maximum. In Non-healthcare applications some individuals might require higher temperatures but even in these cases a temperature of not more than 43°C should be used.

5.1.3 WASH HAND BASIN TEMPERATURES

NHS Estates recommends a maximum of 41°C for a wash hand basin but any temperature between 38°C and 41°C can prove suitable depending on application. This is the only application where people can put their hands directly into running water without waiting for the water to get hot. When the water flow reaches full discharge temperature scalding can occur without warning if not correctly controlled.

5.1.4 BIDET TEMPERATURES

NHS Estates recommends a maximum of 38°C. The comfort band for this type of application is very narrow, therefore the maximum should be followed.

5.1.5 KITCHEN SINK TEMPERATURES

In the kitchen environment practicality and safety from scalding come into direct conflict. Water should be at a temperature of between 46°Cand 48°C to ensure thorough removal of grease, but at the risk of scalding. This application is not covered by any known published recommendations.
However, if the sink is in an area where there are people deemed to be at risk the recommendations for basins contained in NHS Estates guidance should be followed when making the risk assessment.

5.2 GROUP MIXING

5.2.1 GENERAL

Group mixing is not generally recommended for applications accessible by building occupants or people judged to be in a high-risk category. If used, there are a number of recommendations that should be followed for correct application of TMVs.

- The operation of one or more outlets should not affect the operation of any other outlet.
- When one valve is used to supply mixed water to a number of outlets the length of the pipe-run and the volume of mixed water after the valve should be kept to a minimum
- The maximum pipe run after the mixing valve should be such that the required mixed temperature, at the furthest outlet, should be reached within 30 seconds (Reference document 24 in Appendix A)In group shower applications it is not unusual for the pipe-run after the valve to be 10 metres or more. With pipe runs of this length the risk of unacceptable legionella growth is high, often in situations with no alternative system design.

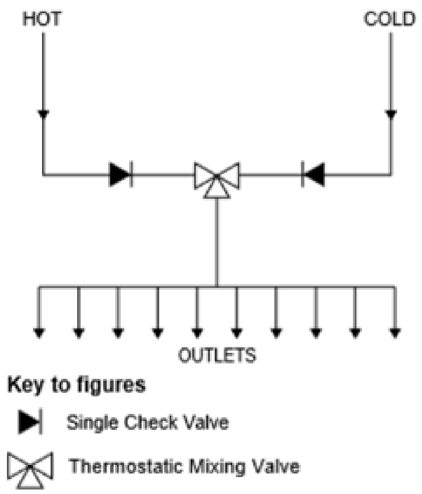
These situations can be dealt with in two ways:

- o Regular monitoring of the showerheads / outlets for signs of Legionella and implement appropriate treatment when detected.
- o Regular hot water disinfection when the system is not in use.

Both options have risks associated with them and the most appropriate system selection should form part of the risk assessment. In some cases, it may be necessary to adopt point of use mixing.

All the above points must be taken into consideration when carrying out the risk assessment.

FIGURE 2: GROUP MIXING



5.2.2 GROUP MIXING APPLICATIONS

i. Group Showers
It is common for an appropriately sized TMV to be used for a number of shower outlets. The discharge temperature is normally between 38°C to 40°C, but for safety should not exceed 43°C.

ii. Rows (groups) of basins
It is common for one valve to be used for a number of basins. Typically, a temperature of 38°C to 40°C would be used for this application, but for safety should not exceed 43°C.

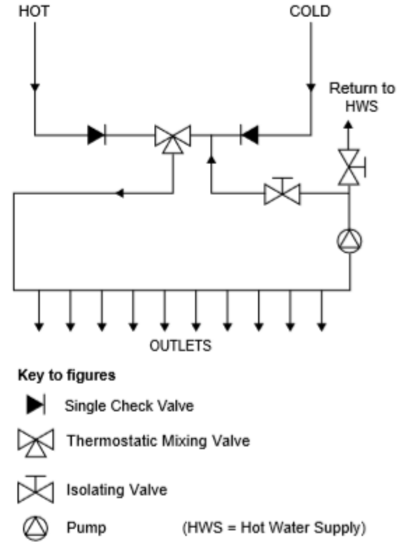
iii. Mixed usage applications
See 6.3 below

5.3 CENTRALISED MIXING

Centralised mixing occurs when water is provided to a variety of applications, whether re-circulated or not. This type of system is appropriate for group showers, basins and other multiple units.
The following guidance should be followed in the design of centralised systems:

- If mixed water is re-circulated within the Legionella growth temperature range, additional anti-legionella precautions will have to be taken. (Examples as 6.2.1)
- If mixed water is re-circulated at above Legionella growth range temperatures, recommendations for single valve operations should be followed.
- The operation of one outlet should not affect the discharge temperature of any other outlet.

FIGURE 3: CENTRALISED MIXING WITH RECIRCULATION



5.4 STORAGE AND DISTRIBUTION

5.4.1 HOT WATER

- To ensure the risk of Legionella is minimised, hot water should be stored at or above 60°C as 90% of legionellae are destroyed after 2 minutes at 60° C: WHO document Legionella and the prevention of legionellosis – 2007 (Reference document 32 in Appendix A).
- The temperature of water introduced into the distribution system must be in excess of 60°C. Temperatures will tend to vary around the system but return temperatures to any store must be a minimum of 55°C.
- In small systems, with normal tap running times and a maximum delay of 30 seconds for the hot water to reach the outlet, the pipes would be subjected to sufficient temperature to kill Legionella (or inhibit growth) without the need of secondary circulation.

5.4.2 COLD WATER

- Cold water storage should be located to ensure that store temperatures never exceed 20°C. They should also be able to be cleaned and drained.
- Cold water distribution temperatures can rise to be within the Legionella range by the close proximity of hot water pipes, even where the pipes are lagged. Therefore, cold water pipes should not be positioned adjacent to hot water pipes. Similarly, cold water pipe runs should be kept short, to reduce the volume of water raised to ambient temperature. High ambient temperatures in small spaces can also cause a rise in temperature which can permeate within pipework without adequate draw off.

5.4.3 CLEANLINESS

All water distribution systems must be correctly cleaned, flushed and disinfected prior to being commissioned (Reference document 32 in Appendix A). The following recommendations are of particular importance for the maintenance of cleanliness:

- All restrictions within the system must be removed, or not installed, prior to flushing the system to ensure that sufficient velocity is maintained to clean the pipework.
- It is not possible to flush a system through line strainers, check valves, pressure-reducing valves, thermostatic mixing valves or taps with aerators fitted.
- Excessive amounts of flux should not be used.
- Dissimilar metals should not be used in pipework systems without taking appropriate precautions against the formation of corrosion pockets.
- Provision shall be made to allow drain down and flush of the storage water heater to prevent the build-up of contamination.
- All water outlets, particularly any spray fittings (taps or showers) should be kept free from the build-up of a biofilm.
- Where parts of the system are left unused for extended periods of time, provision should be made so that it can be disinfected before being put back into use.

5.5 INSTALLATION, COMMISSIONING AND TESTING OF THERMOSTATIC VALVES

The installation, commissioning and testing of in-situ valves is of great importance. Unless these procedures are carried out to the manufacturer's instructions and to all the relevant standards, the protection given by TMVs cannot be guaranteed.

5.5.1 HOW TO TEST TEMPERATURES

Of particular importance is the setting of temperatures once TMVs are installed. The following guidance should be followed where appropriate. Note that while some TMVs are set at the factory during production, they must still be commissioned on site to optimally suit the prevailing site conditions.

- Calibrated digital thermometers of known accuracy, with a minimum refresh rate of 4 times a second are recommended for use. Liquid filled thermometers must not be used.
- Temperature readings should be taken at the normal flow rate after allowing for the system to stabilise. The end of the digital thermometer probe must be fully immersed in the water that is being tested.
- When reading the discharge temperature of a spray fitting the water should be collected, as close to the discharge as possible, in a small container and the reading taken only after the container and all the contained water has reached a stable temperature.
- Where possible the stored water temperature should be measured. An uncontrolled hot water outlet (or drain point) at the beginning of the circulation system can be used for this. If there are no uncontrolled outlets (or drain points) then an under-basin thermostatic valve at the beginning of the secondary return loop or as close to the water heater as possible should be selected. The set temperature of this valve should then be set to maximum and the cold-water supply turned off. The temperature of the residual flow (full hot temperature) can then be measured.
- Return temperatures can be measured in the same way, but at an outlet (or drain) at the end of the circulation system.
- Any TMV that has been adjusted must be recommissioned and re-tested in accordance with the manufacturers' instructions after the hot water temperatures have been measured.

6
Appendix A – REFERENCE DOCUMENTS

Current Regulation, Legislation, Standards and Guidance documents

1. The Water Supply (Water Fittings) Regulations (England & Wales) – 1999 http://www.legislation.gov.uk/uksi/1999/1148/contents/made/data.pdf
2. Water Byelaws (Water Fittings) (Scotland) – 2014 https://www.scottishwater.co.uk/-/media/domestic/files/investment-and-communities/water-byelaws-consultation-apr-14/thewatersupplywaterfittingsscotlandbyelaws2014finaldraftfornotification.pdf?la=en
3. Water Supply (Water Fittings) Regulations (Northern Ireland) - 2009 https://www.niwater.com/sitefiles/resources/waterregs/the-water-supply-water-fittings-regulations-northern-ireland-2009.pdf
4. Registered Homes Act 1984 http://www.legislation.gov.uk/ukpga/1984/23/part/I/enacted
5. Employers Liability (Compulsory Insurance) Act -1969 https://www.google.com/search?q=11.+Employers+Liability+(Compensation+Insurance)+Act+1969&oq=11.+Employers+Liability+(Compensation+Insurance)+Act+1969&aqs=chrome..69i57.1556j0j4&sourceid=chrome&ie=UTF-8
6. Nursing Homes and Nursing Agencies Act (Northern Ireland) – 1986 http://www.legislation.gov.uk/nisr/1986/338/pdfs/nisr_19860338_en.pdf
7. Registered Establishments (Scotland) Act – 1987 http://www.legislation.gov.uk/ukpga/1987/40/contents
8. Control of Substances Hazardous to Health Regulations – 1994 http://www.legislation.gov.uk/uksi/2002/2677/regulation/7/made
9. The Health and Safety at Work Act – 1974 https://www.legislation.gov.uk/ukpga/1974/37
10. SI 2051: The Management of Health and Safety at Work Regulations – 1992 http://www.legislation.gov.uk/uksi/1992/2051/made
11. SI 1039: (NI 9) Health and Safety at Work (Northern Ireland) Order – 1978 http://www.legislation.gov.uk/nisi/1978/1039/contents
12. SI 459: The Management of Health and Safety at Work Regulations (Northern Ireland) – 1992 https://www.legislation.gov.uk/nisr/1992/459/made
13. Building Regulations (England), Part G - Sanitisation, hot water safety and water efficiency – 2016 https://www.planningportal.co.uk/info/200135/approved_documents/69/part_g_-_sanitation_hot_water_safety_and_water_efficiency
14. BS 806-1: Specifications for installations inside buildings conveying water for human consumption. General – 2000 https://shop.bsigroup.com/ProductDetail/?pid=000000000030064693
15. BS 806-2: Specifications for installations inside buildings conveying water for human consumption. Design – 2005 https://shop.bsigroup.com/ProductDetail/?pid=000000000030011044
16. BS 806-3: Specifications for installations inside buildings conveying water for human consumption. Pipe sizing. Simplified method – 2006 https://shop.bsigroup.com/ProductDetail/?pid=000000000030098799
17. BS 806-4: Specifications for installations inside buildings conveying water for human consumption. Installation – 2010 https://shop.bsigroup.com/ProductDetail/?pid=000000000030218140

18. BS 806-5: Specifications for installations inside buildings conveying water for human consumption. Operation and maintenance – 2012
https://shop.bsigroup.com/ProductDetail/?pid=000000000030200074
19. BS 8558: Guide to the design, installation, testing and maintenance of services supplying water for domestic use within buildings and their curtilages – 2015 *Complementary guidance to BS EN 806*
https://shop.bsigroup.com/ProductDetail/?pid=000000000030299695
20. BS 1111: Sanitary tapware – Thermostatic mixing valves (PN10) – 2017
https://shop.bsigroup.com/ProductDetail/?pid=000000000030321803
21. BS 1287: Sanitary tapware - Low pressure thermostatic mixing valves General technical specification – 2017 https://shop.bsigroup.com/ProductDetail/?pid=000000000030321800
22. BS 7942: Thermostatic Valves for use in care establishments – Requirements and test methods – 2011
https://shop.bsigroup.com/ProductDetail/?pid=000000000030182724
23. BS 15092: Building Valves. Inline hot water supply tempering valves. Tests and requirements – 2008. https://shop.bsigroup.com/ProductDetail/?pid=000000000030126824
24. DoH HTM04-01 Safe Water in healthcare premises – Part A: Design, installation and commissioning – 2016
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https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_da ta/file/148497/HBN_00-10_Part_C_Final.pdf
29. HSE HSIS6 - Managing the risk from hot water and surfaces in health and social care – 2012 http:// www.hse.gov.uk/pubns/hsis6.htm
30. HSE L8 (fourth edition) ACOP Legionnaires' disease. The control of legionella bacteria in water systems - 2013 http://www.hse.gov.uk/pUbns/priced/l8.pdf
31. HSE HSG220 Health and Safety in Care Homes – 2014
http://www.hse.gov.uk/pubns/priced/hsg220.pdf
32. HSE HSG274 Part 2: The control of legionella bacteria in hot and cold water systems – 2014 http:// www.hse.gov.uk/pubns/priced/hsg274part2.pdf
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34. NHS HGN Safe hot water and surface temperatures – 1998
http://www.coverad.co.uk/nhsguidelines_1.pdf
35. BRE IP14/03: Preventing hot water scalding in bathrooms: using TMVs – 2003
https://www.brebookshop.com/details.jsp?id=144605
36. WHO Healthcare Associated Infections (HCAI)
https://www.who.int/gpsc/country_work/gpsc_ccisc_fact_sheet_en.pdf?ua=1

37. WHO Global priority list of antibiotic-resistant bacteria to guide research, discovery, and development of new antibiotics http://www.who.int/medicines/publications/WHO-PPL-Short_Summary_25Feb-ET NM_WHO.pdf

38. WHO Legionella and the prevention of legionellosis – 2007 https://apps.who.int/iris/bitstream/handle/10665/43233/9241562978_eng.pdf?sequence=1&isA llowed=y

39. Consumer Affairs Directorate, DTI. 'Government consumer safety research – Burns and scalds accidents in the home' – June 1999. https://www.humanics-es.com/burns.pdf

40. NSF (ex-Buildcert) TMV2 and TMV3 Schemes - https://www.nsf.org/services/by-industry/water-wastewater/plumbing-fixtures/anti-scald-and-temperature-control-devices

41. BEAMA website http://www.beama.org.uk/heating-and-ventilation/water-safety-and-hygiene.html

42. IPC CH:Hand Hygiene https://www.infectionpreventioncontrol.co.uk/resources/hand-hygiene/

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