Thermostatic Mixing Valve Manufacturers Association

Recommended Code of Practice for Safe Water Temperatures

CONTENTS

1.0 INTRODUCTION

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 the 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 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.

All these injuries are wholly preventable by the installation and use of appropriate safety products.

This Code of Practice document has been prepared by the members of the Thermostatic Mixing Valve Manufacturers Association (TMVA) for the use by building managers, consulting engineers and installers and other interested parties. It uses information from a wide range of reference publications and is accurate to the best knowledge of the TMVA. The document is intended to give clear guidance but does not supersede any current legislation or standards.

The guidance given in the document is relevant for all non-domestic installations, including:-

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

This document is primarily concerned with non-domestic installations although the guidance given is equally appropriate in domestic situations.

Any reader of the Code of Practice requiring further information on any aspect of the guidance, or on any other aspect relating to Thermostatic Mixing Valves should contact the association at the address below:

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2.0 THE RISKS

There are two areas of risk covered by this document.

a. Scalding from hot water
b. Legionella Infection typically from stored hot water

Both these areas of risk arise from the storage and delivery of hot water for use by 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.

Hot water temperatures that do not cause scalding are ideal for the legionella bacteria to grow in a water system.....but hot water temperatures that kill the legionella bacteria will cause scalding.

3.0 THE FACTS

3.1 Scalding

Scalding can occur in many situations in all types of building both public and private. In whichever situation, the temperatures at which scalding can occur are constant, but the **degree** of potential scalding does depend on the actual temperature and volume of delivered hot water and the contact time.

Evidence on scalding (Ref.1,2), indicates a risk increasing rapidly from temperatures of 45ºC and above. For example, partial thickness burns will occur within 30 seconds at 55ºC, reducing to less than 5 seconds at 60ºC and above. These examples are taken from figures represented in the NHS Estates Health Guidance note, "SAFE' hot water and surface temperatures' (Ref. 1) but are only guideline figures. Skin sensitivities vary greatly throughout the population, as do the risks from high temperatures for the population with specific medical conditions.

3.1.1 Recommended safe hot water temperatures

The NHS Estates Health Guidance Note, 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 (Ref 3) but are applicable for other types of occupied building.

A 44ºC For an unassisted bath fill

B 46ºC For an assisted bath fill (**)

C 41ºC For shower applications

D 41ºC For washbasin applications

E 38ºC 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.

3.2 Legionella

Legionella bacteria are naturally occurring organisms present in many water systems, and if exposed to human beings can cause the development of Legionnaires' disease.

The evidence for the occurrence of Legionella in water systems varies between different reports. The most representative information is summarised in a HSE ACOP document (Ref 4), which states:

- Legionella bacteria will die at temperatures above 60ºC.
- Legionella bacteria proliferate between 20ºC and 45ºC.
- Legionella bacteria will not multiply at temperatures below 20ºC, but will remain as a potential threat in the system.

3.2.1 Recommended measures to control Legionella

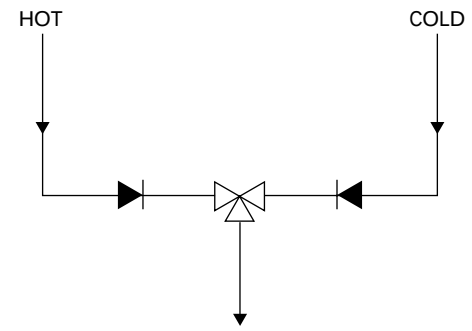
- The water distribution system should always be maintained in a hygienic condition.
- Ensure that water supplies are distributed to the point of mixing, either below 20ºC for cold supplies or above 55ºC for hot supplies.
- Hot water should be stored at or above 60ºC.

4.0 THE CONTROL OF DISCHARGE TEMPERATURES

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 control system are to store water at above 60ºC , distribute water at 55-60ºC, yet deliver water at discharge temperatures between 35-46ºC.

The most effective means to achieve both objectives is to store and distribute water at high temperatures and use Thermostatic Mixing Valves (TMVs) to reduce discharge temperatures to appropriate levels.

FIGURE 1: SINGLE POINT USE



Key to figures

Single Check Valve

Thermostatic Mixing Valve

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 (Ref 1) can be applied to all types of property.

Detailed guidance in this section refers to the following areas:

4.1 Single valve applications
4.2 Group mixing
4.3 Centralised mixing
4.4 Storage and distribution

4.1 Single valve applications (Point of use mixing)

The use of a single TMV is common for a range of applications as listed below. 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.

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

4.1.1 Bath fill temperatures

- Normally a set temperature between 41ºC and 44ºC 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 44ºC should only be considered in exceptional circumstances. (3.1.1)

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.

4.1.2 Shower temperatures

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

4.1.3 Wash hand basin temperatures

NHS Estates recommends a maximum of 41ºC for a hand wash basin but any temperature between 38ºC and 41ºC 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.

4.1.4 Bidet temperatures

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

4.1.5 Kitchen sink temperatures

In the kitchen environment practicality and safety from scalding come into direct conflict. Water should be at a temperature of between 46ºC and 48ºC 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.

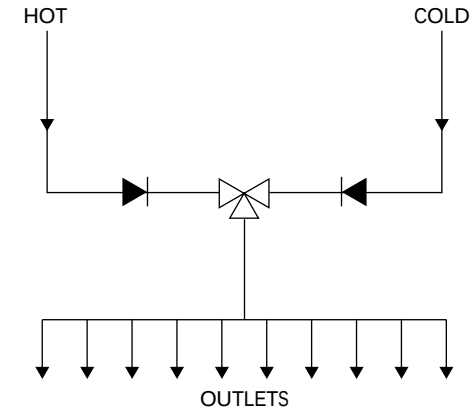
4.2 GROUP MIXING

4.2.1 General

Group mixing is not generally recommended for applications accessible by building occupants or patients 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 effect 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.
- In group shower applications it is not unusual for the pipe run after the valve to be 10 meters 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:

FIGURE 2: GROUP MIXING



Key to figures

Single Check Valve

Thermostatic Mixing Valve

- Regular monitoring of the showerheads / outlets for signs of Legionella and appropriate treatment when detected.

- Regular hot water disinfection when the system is not in use.

Both systems 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 making the risk assessment.

4.2.2 Group Mixing Applications

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 38ºC to 40ºC, but for safety should not exceed 43ºC.

Rows (groups) of basins

It is common for one valve to be used for a number of basins. Typically a temperature of 38ºC to 40ºC would be used for this application, but for safety should not exceed 43ºC.

Mixed usage applications

See 4.3

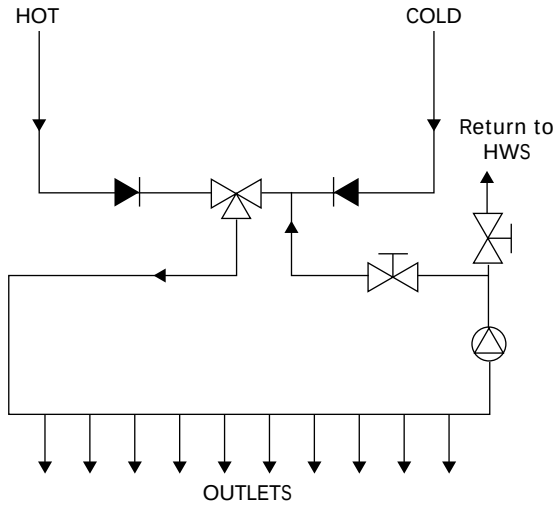
4.3 CENTRALISED MIXING

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 4.2.1)
- 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 effect the discharge temperature of any other outlet.

FIGURE 3: CENTRALISED MIXING WITH RECIRCULATION



Key to figures

Single Check Valve

Thermostatic Mixing Valve

Isolating Valve

Pump (HWS = Hot Water Supply)

4.4 STORAGE AND DISTRIBUTION

4.4.1 Hot water

- Hot water should be stored at or above 60ºC. This will ensure that Legionella is eliminated.
- The temperature of water introduced into the distribution system must be in excess of 60ºC. Temperatures will tend to vary around the system, but return temperatures to any store must be a minimum of 55ºC.
- 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.

4.4.2 Cold water

- Cold water storage should be located to ensure that store temperatures never exceed 20ºC. They should also be able to be cleaned and drained.
- Cold water distribution temperatures can be increased to within the Legionella range by the close proximity of hot water pipes. 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.

4.4.3 Cleanliness

All water distribution systems must be correctly flushed out prior to being commissioned. (Ref 5)

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.

5.0 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.

5.1 How to test temperatures

Of particular importance is the setting of temperatures once TMVs are installed. The following guidance should be followed where appropriate.

- 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 submerged in the water that is to be 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.

6.0 THE LEGAL POSITION

There are 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 is only recommended by the TMVA. Appropriate legal advice should be taken to determine particular requirements.

- 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.

6.1 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 not comprehensive.

- The Health and Safety at Work Act 1974.
- The Prevention or Control of Legionellosis L8 (REV)
- SI 2051: 1992 The Management of Health and Safety at Work Regulations.
- SI 1039: 1978 (NI 9) Health and Safety at Work (Northern Ireland) Order.
- SI 459: 1992 The Management of Health and Safety at Work Regulations (Northern Ireland)
- Registered Homes Act 1984
- Nursing Homes and Nursing Agencies Act (Northern Ireland) 1971
- Registered Establishments (Scotland) Act 1987
- Control of Substances Hazardous to Health Regulations 1994.
- The Water Supply (Water Fittings) Regulations 1999 for England and Wales, Water Bylaws 2000 (Scotland) and Water Regulations (Northern Ireland)

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 statuary duties could invalidate third party liability insurance). (Ref 6)

6.2 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', 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."

7.0 STANDARDS

There is a wide range of standards that have relevance in this sector:

- NHS Estates Model Engineering Specification D08. 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 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 1415 Pt 2 1986 (Replaced by BS EN 1111 and BS EN 1287). 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. Manufacturers self certify valves as complying with this standard.

- Group mixing and Centralised mixing valves. There is no generally accepted performance standard for these valves but these valves must at least be in compliance with BS 1415 Pt 2: 1986 or an equivalent European Standard. Some valves approved to D08 are suitable, because of their particular flow rate, for these applications. Such valves will generally have a better control characteristic than valves claimed to comply with BS 1415 Pt 2 1986 or its BS EN replacements.

- 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 6700: 1997 Specification for design, installation, testing and maintenance of services supplying water for domestic use within buildings and their curtilages. This will be replaced either in whole or part by EN 806-2.

- BS 7942: 2000, Thermostatic Valves for use in care establishments.

7.1 NHS Estates Health Guidance Note

The 'SAFE' hot water and surface temperatures' guidance note, revised in 1998, is accepted as best possible practice.

NHS Estates together with TMV manufacturers have co-operated to establish a Third Party Certification scheme (TMV3 Scheme), and administered by WRc Evaluation and Testing Centre. The Scheme test 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, see 7.0.

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.

7.2 Requirements of the Water Supply (Water Fittings) Regulations

These replace the Water Byelaws and cover waste, misuse, contamination, undue consumption and erroneous measurement of water supplied by a water undertaker. They do not cover fitness of purpose.

All materials in contact with water must not effect it's 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 Notes cited in the listing.

APPENDIX A

References, Current legislation and recommendation documents

A1 References

1 'NHS Estates Health Guidance Note - 'SAFE' hot water and surface temperatures', NHS Estates 1998.

2 'Government consumer safety research – Burns and scalds accidents in the home', Consumer Affairs Directorate, DTI. June 1999.

3 Registered Homes Act 1984

4 HSE ACOP, 'The prevention and control of legionellosis (including legionnaires disease)

5 Statutory Instrument 1999 No.1148,' The Water Supply (Water Fittings) regulations 1999 (England & Wales) Water Byelaws 2000 (Scotland), Water Regulations (Northern Ireland)

6 Employers Liability (Compensation Insurance) Act 1969

A2 Other current legislation and recommendation documents

- The Health and Safety at Work Act 1974.
- The Prevention or Control of Legionellosis L8 (REV)
- SI 2051: 1992 The Management of Health and Safety at Work Regulations.
- SI 1039: 1978 (NI 9) Health and Safety at Work (Northern Ireland) Order.
- SI 459: 1992 The Management of Health and Safety at Work Regulations (Northern Ireland)
- Nursing Homes and Nursing Agencies Act (Northern Ireland) 1971
- Registered Establishments (Scotland) Act 1987
- Control of Substances Hazardous to Health Regulations 1994.
- BS 1415 Pt 2: 1986 Specification for thermostatic mixing valves.
- Essentially a low pressure standard (tests at 0·2 bar) with high (20ºC) temperature differential.
- BS EN1111 "Sanitary tapware – Thermostatic mixing valves PN10"
- BS EN1287 "Sanitary tapware - Low pressure thermostatic mixing valves"
- BS 6700: 1997 Specification for design, installation, testing and maintenance of services supplying water for domestic use within buildings and their curtilages. This will be replaced either in whole or part by EN806-2.
- BS 7942: 2000 Thermostatic Valves for use in care establishments
- HTM 2040 The control of legionellae in healthcare premises. NHS Estates
- HTM 2027 Hot and cold water supply, storage and mains services. NHS Estates
- SI 1999 No. 1148 The Water Supply (Water Fittings) Regulations 1999
- SI 1999 No. 1506 The Water Supply (Water Fittings) (Amendments) Regulations 1999
- Water Byelaws 2000 (Scotland)
- Water Regulations (Northern Ireland)

Thermostatic mixing valves are designed, constructed and tested to meet specific industry standards and their design performance should be appropriate to the application.

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 market and in any other application where the user is deemed to be at risk.

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