Thermostatic Mixing Valves

The Bathroom Academy
in partnership with
Strategic Professionals

Thermostatic Mixing Valves
Generic Industry Guide

Welcome to the Thermostatic Mixing Valves Generic Industry Guide one in a series of Industry Guides which are available free of charge from the Bathroom Academy Web Site.

We have aimed to make the contents of the Guides both informative and relevant and hope you will consider them a valuable aid to your continuing professional development and that of your colleagues, within the Bathroom Industry.

Each guide has been written by experts and contains the same five elements:

- Right choice of product for end user needs
- Generic industry design
- Generic industry installation
- Frequently asked questions
- Generic industry terminology

The Thermostatic Mixing Valves Generic Industry Guide looks at the vast range of thermostatic mixing valves that are available and offers essential information which will allow the Retailer, Merchant and Installer to provide items best suited to the end user's needs, whilst the customer's major considerations will be cost, functionality, durability and aesthetics. It is also essential to consider a number of important additional factors; available space, storage requirements and the materials used to manufacture the furniture and its' suitability and compatibility with the bathing and/or showering suite within the bathroom.

Other guides in the series are:

- Baths
- Bathroom Furniture
- Brassware
- Domestic Water Systems
- Sanitaryware and Fittings
- Shower Controls
- Shower Enclosures
- Shower Trays
- Wetrooms

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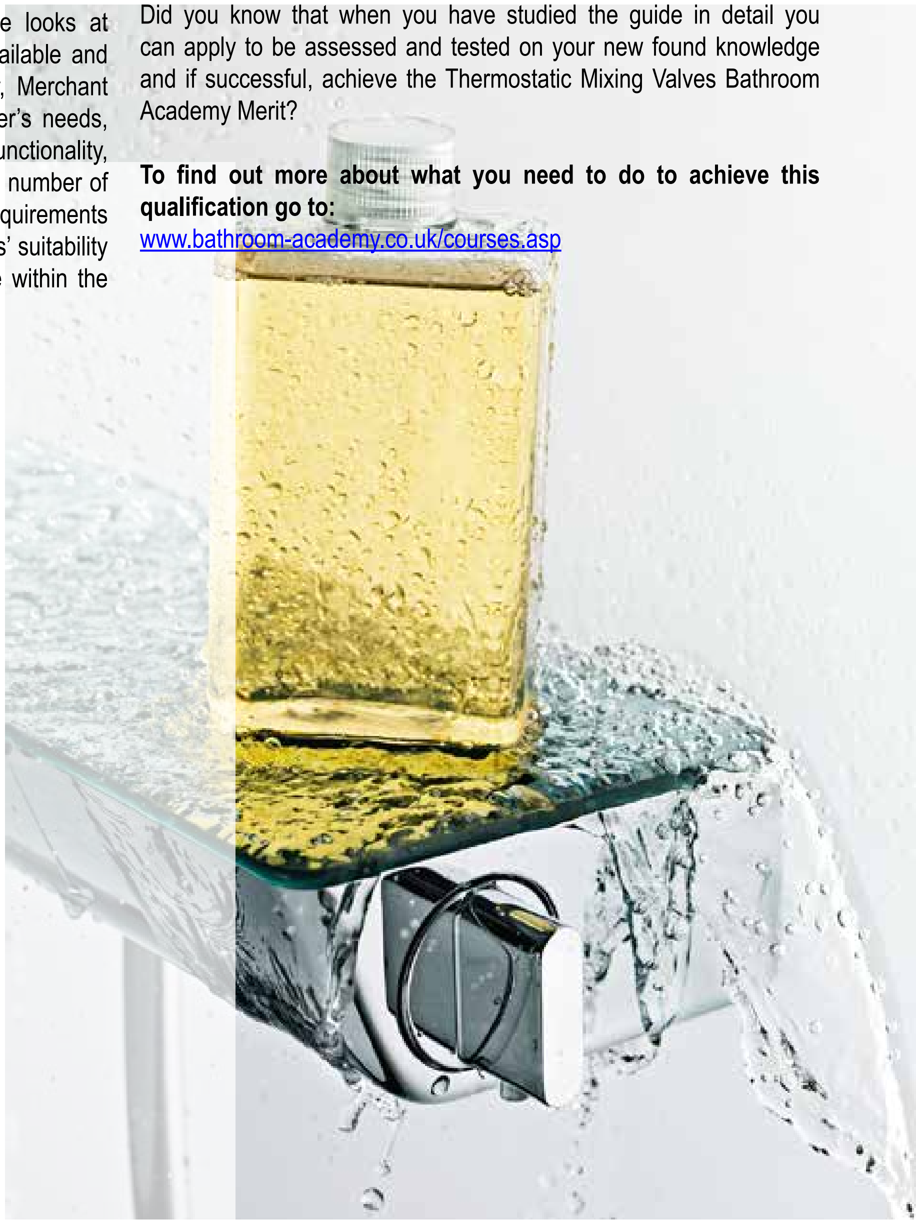


Contents

Introduction

This guide provides essential information on the different types of Thermostatic Mixing Valves (TMVs) available and highlights necessary considerations to ensure the correct choice of product to satisfy the needs of the end user.

What is a Thermostatic Mixing Valve?
Quite simply a thermostatic mixing valve is a device that mixes hot and cold water before discharging it at a stable temperature.

Where are TMVs used?
Domestically TMVs are most commonly used as showers. However, TMVs can be found in a number of other applications around the home ranging from controls on solar thermal hot water systems to taps and bidet controls.

Outside of domestic installations TMVs are often used for safety reasons in Hospitals and care homes, showering controls in sports centres and even process controls in factories. This is because warm water encourages bacteria to grow and hot water kills it but can cause scalds.

TMVs and the law
As of the 1st of May 2006 the Scottish Building Standards Agency introduced mandatory requirements for all new build and major refurbishment work (i.e. when Building Regulation approval is required) to prevent scalding by controlling the maximum temperature of water discharged from, or to, any bath or bidet (domestic situations) to a maximum of 48°C. As of the 6th April 2010, similar requirements were incorporated into The Building Regulations 2000 Approved Document G for Sanitation, hot water safety and water efficiency.

There is also guidance within the Water Supply (Water Fittings) Regulations 1999 that recommends the use of thermostatic mixing valves in schools, public buildings and other public facilities.

Why are TMVs becoming mandatory to fit?
Hot bath water is responsible for the highest number of fatal and severe scald injuries in the home. Young and old are most at risk because their skin is thinner and less tolerant to high water temperatures.

According to the National Network for Burn Care: Acute injury admissions to specialised burns services in England and Wales number approximately 300 people each year suffering with scalds associated with tap water and bathing immersion, most of these incidents occur in their own home.

Section 1

Types of Thermostatic Mixing Valves

To help understand exactly what first, second and third degree burns are and how serious they can be, see the following classification table and descriptions at various hot water temperatures[1].

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

Time of exposure
e=estimated time
m = minutes
s = seconds

[1] Ref: Dr J P Bull, Industrial Injuries and Burns Unit Medical Research Council

First degree burns are usually limited to redness (erythema) a white plaque and minor pain at the site of injury. These burns only involve the epidermis.

Second degree burns manifest as erythema with superficial blistering of the skin, and can involve more or less pain depending on the level of nerve involvement. Second degree burns involve the superficial (papillary) dermis and may also involve the deep (reticular) dermis layer.

Third degree burns occur when the epidermis is lost with damage to the subcutaneous layer (layer of fat that lies between the dermis of the skin and underlying fascia). Burn victims will exhibit charring and extreme damage of the epidermis, and sometimes hard eschar (piece of dead skin) will be present. Third degree burns result in scarring and victims will also exhibit the loss of hair shafts and keratin. These burns may require grafting.

Nomenclature	Superficial Thickness	Partial Thickness - Superficial	Partial Thickness - Deep	Full Thickness
Traditional Nomenclature	First Degree	Second Degree	Second Degree	Third or Fourth Degree
Depth	Epidermis Involvement	Superficial (papillary) dermis	Deep (reticular) dermis	Dermis and underlying tissue and possibly fascia bone or muscle
Clinical Findings	Erythema, minor pain lack of blisters	Blisters, clear fluid and pain	White appreance, with decreased pain. Difficult to distinguish from full thickness	Hard leather like eschar, purple fluid, no sensation

TMVs can be used to control water at a safe preselected temperature thus minimising the possibility of anyone sustaining a serious scald injury.

This guide has been produced by the Bathroom Manufacturers Association (BMA) with help from its' manufacturing members. It aims to help you make the correct choice of product. It also references key requirements of Water Regulations, National Standards and good plumbing practice.

This guide is not a replacement for Water Regulations/Byelaws (in Scotland) or any other relevant regulations or code of practice. In case of any doubt concerning the installation of any TMV or associated product, the full text of the Water Regulations, manufacturers' installation instructions and the requirements of any local codes or regulations should be consulted. Advice may also be available from your local water supplier.

Important Note.

Answers to questions regarding the specific capabilities and installation requirements of a particular product must be sought directly from the manufacturer of the product.

There are many types of thermostatic mixing valve in terms of how the product looks and also in terms of the capability of the product. However, there are also major differences in methods used to control the mixed water to enable the discharge of water at a stable temperature.

Differing Thermostatic Mechanisms

Wax capsule

A copper capsule containing a mixture of wax and fine metal particles is situated in the mixed water section of the valve. Heat transfer into the capsule causes the wax to expand, if cooled the wax contracts. As the wax expands it forces a metal piston out of the top of the capsule. This force is transferred on to a shuttle which moves forward and backward thus proportioning the amount of hot and cold water entering the valve. Typically the movement of the shuttle, when the wax contracts, is made by a spring that acts on the shuttle as the wax capsule is only able to directly move the shuttle in one direction i.e. as the capsule expands.

The wax capsule, in combination with the spring, continually move the shuttle to proportion that mix of hot and cold water thus maintaining a stable temperature. The wax capsule will attempt to maintain this stable temperature by compensating for inlet water temperature and pressure changes.

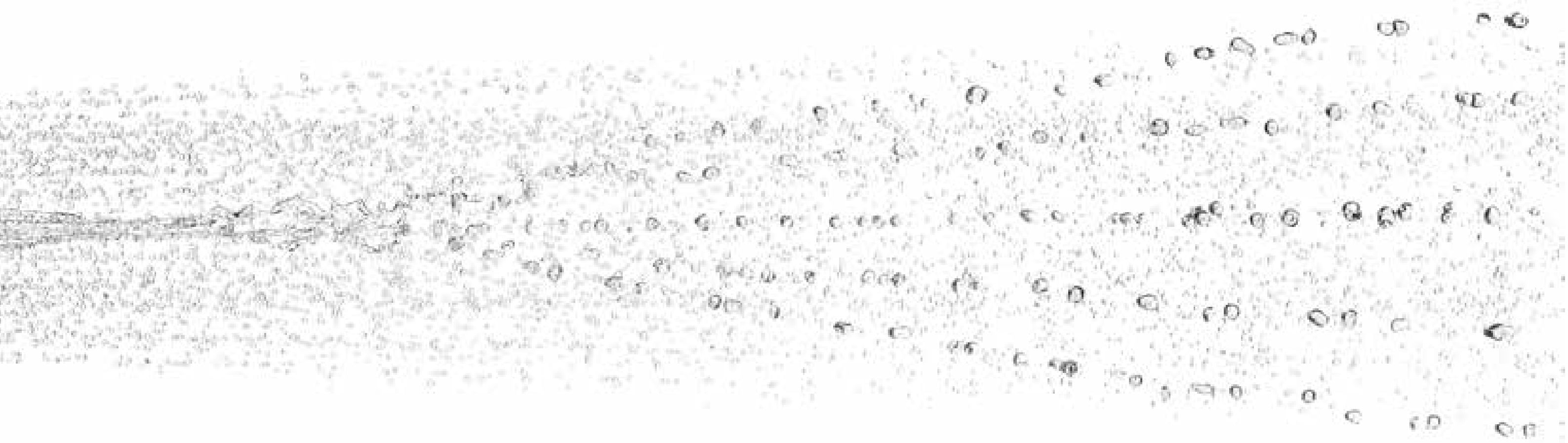
Bi-metallic

In this case a bi-metallic coil is situated within the mixed water chamber. When water flows over the coil thus changing its temperature, the coil expands or contracts accordingly. The movement of the coil is therefore used to alter the position of a shuttle which is attached to the coil. As with the wax capsule mechanism, movement of the coil changes the proportions of the hot and cold water entering the mixing chamber and thus maintains a stable temperature.

Electronic/digital

Electronic/digital methods of maintaining thermostatic control of water systems is somewhat in its infancy. However, these types of systems are starting to have an impact in the market. The hot and cold water supplies can be controlled by a number of methods from proportioning valves, pumps or motorised controls.

Whichever system is used the water should be maintained at a stable temperature during normal use and operating conditions at the terminal fitting whether this is a pillar tap or a shower head.



Section 2

Differing Mechanical Configurations

As well as all the differing thermostatic mechanisms, TMVs can also come in a large variety of mechanical configurations.

'T' pattern

As the name suggests the configuration of these types of valves are typically in the shape of the letter 'T'. The two horizontal connections opposite each other are for the hot and cold inlet supplies and the vertical connection is for the outlet mixed/blended supply water.

'T' pattern TMVs can also come with an array of accessories to enable a simplified routine maintenance schedule and to make the removal of a valve, should it be necessary, easier than with direct compression connections.

These valves are typically situated under a basin or bath and the mixed water outlet plumbed into a pillar tap or single lever mixer tap. They are usually set and locked to stop the end user from adjusting the maximum mixed water temperature as a safety precaution. They have no on/off flow control and therefore need to be paired with a pillar tap, mechanical single lever mixer or other suitable terminal fitting.

Showers - Single Sequential

TMVs are most commonly used as showers. However, there are a number of different configurations that need to be highlighted. Single sequential TMVs have one control that turns the water flow on and off and adjusts the temperature at the same time. Higher or lower flows typically cannot be selected without changing the mixed water temperature.

Showers - Dual control

Many TMV shower products have one control to turn the water flow on and off and a separate control to change the mixed water temperature.

These controls are typically arranged as separate control knobs or as concentric controls.

Showers – Built in

As the name suggests these TMV showers have the body of the valve located either behind a panel e.g. a stud partition or are literally built into a solid wall. This effectively only leaves the control knobs exposed.

Showers – Exposed

These shower TMVs are literally mounted on the surface of the wall and usually allow for either surface mounted or concealed pipework. Most manufacturers offer different style options of the same shower TMV in both built in and exposed versions – the major difference being the style the product offers to satisfy the needs of the end user.

Bath Shower Mixers

Bath shower mixing valves (BSM) are obviously designed to deliver water to either the bath or to a shower. As with showers and taps, there are a number of different designs available that offer differing options. Selection of outlet is usually by use of a diverter – these can be levers or manual diverters or automatic diverters (which return to the original outlet when the water flow is turned off). Many traditional BSMs only delivered water to the shower that was mixed and controlled by the TMV part of the product. When delivering water to the bath outlet, these products act as a manual mixing valve. As a manual mixing valve the mixed water outlet is not controllable to a stable temperature in the same way as a TMV. However, many manufacturers now offer BSMs that are truly thermostatic and thus thermostatically control the outlet water to both shower and bath outlets (when selected) to a stable temperature.

As with showers and BSMs there are a host of designs ranging from single sequential designs to dual control designs. Most variants are single fixing hole styles for fitting to the basin but some may be two fixing hole fittings.

Bath Fill

Single or dual controlled to allow for safe, controlled water temperature to fill the bath in accordance with the Building Regulations 2000 Approved Document G for Sanitation, hot water safety and water efficiency.

Thermostatic Taps

Take a hot and cold supply and blend to a safe, controlled temperature virtually at the point of use.

Bidets

Manufacturers may also produce specific tap designs for use with bidets.

Section 3

Factors Affecting Choice of Product

Many factors may affect the final choice of TMV. The vast array of TMVs available to the end user, what benefits they offer and how well they can perform can seem bewildering. That is not to mention that cost and aesthetics will also be taken into account by the end user.

End use – safety capability

Typically the safety aspects that TMVs can provide are not the primary reason for selection within the bathroom environment. However, care should be taken to understand the safety features and the types of product approvals available and therefore what they may mean to the end user.

All products should demonstrably comply with the Water Supply (Water Fittings) Regulations 1999 and Water Byelaws Scotland 2000. It is an offence to install and/or use products that do not comply with these Regulations. Compliance with these Regulations should ensure that any product fitted to the water supply is durable and will not contaminate the water supply.

As of the 1st of May 2006 the Scottish Building Standards Agency introduced mandatory requirements for all new build and major refurbishment work (i.e. when Building Regulation approval is required) to prevent scalding by controlling the maximum temperature of water discharged from, or to, any bath or bidet (domestic situations) to a maximum of 48°C. As of the 6th April 2010, similar requirements were incorporated into The Building Regulations 2000 Approved Document G for Sanitation, hot water safety and water efficiency. Wales and Northern Ireland also have requirements for the protection of scalding within the bathroom of new dwellings.

In addition to the basic requirements of Water Regulations there are a number of published British and Industry Standards that cover the performance and safety aspects of TMVs. While compliance with these British Standards is not mandatory, best practice for TMV manufacturers is to seek an independent third party product approval to demonstrate effectively the functional capability of a product.

BS EN 1287 and 1111 require performance to be measured for:-

Minimum flow rate

- 15 litres per minute (lpm) for baths on low pressure systems.
- 4.7 lpm for showers and other valves on low pressure systems.
- 20 lpm for baths on high pressure systems.
- 12 lpm for showers and other valves on high pressure systems.

Temperature stability with changing inlet pressures

The TMV must maintain the set mixed water temperature to within ±2°C of the set temperature while the inlet pressures to either supply are changed. For low pressure systems the inlet pressure is reduced from 0.2 to 0.1 bar. For high pressure systems the inlet pressure is reduced from 3.0 bar to 2.0 bar.

Temperature stability with changing inlet temperatures

The TMV must maintain the set mixed water temperature to within ±2°C of the set temperature while the inlet temperature is changed. The hot inlet temperature is increased and decreased by 10°C.

Sensitivity of temperature controls

The temperature control, where fitted, must provide a large enough movement to ensure that it can be easily set to the desired temperature. This is a minimum movement of 12mm in the 34 to 42°C temperature range.

Temperature stability at reduced flow rate

The set temperature must not deviate by more than ±2°C while the outlet flow rate is reduced.

Thermal shut off

The TMV has to significantly reduce the flow of water through the valve in the event that the cold supply to the valve is lost. When the cold supply is stopped then the valve should not allow an excessive volume of water to be discharged. As scalding is a function of both temperature and volume, if this volume is exceeded then the temperature of the collected water cannot exceed 42°C. Obviously the hotter the water temperature then the smaller the volume required to cause scalds.

BS 7942 and Department of Health (DH) D 08 (require performance to be measured for similar tests as those described. However, the testing is generally considered to be more extreme (than BS EN 1111 and 1287) and the capability of the TMV being tested must therefore be able to perform at this higher level. These standards are also more specific in that each valve is tested to specific requirements for the intended application. The applications being bidet, washbasin, shower, and bathfill in addition to both high and low pressure. All valves are also required to be able to have the maximum temperature set on them in a fashion that cannot be overridden by the end user.)

Application	Abbreviated Designation	Maximum Mixed Water Set Temperature
Bidet	LP-B, BE, HP-B, BE	38°C
Washbasin	LP-W, WE, HP-W, WE	41°C
Shower	LP-S, SE, HP-S, SE	41°C
Bath	LP-T44, HP-T44	44°C
Assisted Bath	LP-T46, HP-T46	46°C

These standards are also very prescriptive regarding the supply pressures and temperatures that are supplied to the TMV. They must be within the following limits to enable the valve to actually provide the correct level of safety intended.

Operating Pressure Range	High Pressure (BS EN 1111)	Low Pressure (BS EN 1287)
TMV Type 2		
Maximum static pressure	10 bar	10 bar
Flow pressure, hot & cold	0.5 to 5.0 bar	0.1 to 1.0 bar
Hot supply temperatures	55°C to 65°C	55°C to 65°C
Cold supply temperatures	Up to 25°C	Up to 25°C
TMV Type 3		
Maximum static pressure	10 bar	10 bar
Flow pressure, hot & cold	1.0 to 5.0 bar	0.2 to 1.0 bar
Hot supply temperatures	55°C to 65°C	55°C to 65°C
Cold supply temperatures	5°C to 20°C	5°C to 20°C

In addition to valves being suitably selected for the appropriate application that they have been approved for, the Department of Health further classifies all mixing valves into a number of different Types. Typically the difference in the Types help to identify the expected performance capability of the different types of mixing valve.

Within health care premises mixing valves are classified in the following manner:

- Type 1 – a mechanical mixing valve, or tap with maximum temperature stop where appropriate.
- Type 2 – a thermostatic mixing valve, generally complying with BS EN 1111 and/or BS EN 1287 with maximum temperature stop.
- Type 3 – a thermostatic mixing valve with enhanced thermal performance complying with DH (D 08).

Products designed to comply with the requirements of BS EN 1111 and/or BS EN 1287 may be eligible to gain approval by BuildCert or KIWA to their Type 2 approval scheme.

Products designed to comply with the requirements of BS 7942 or DH performance Specification D 08 may be eligible to gain approval by BuildCert or KIWA to their Type 3 approval scheme.

Compliance of a Type 2 or Type 3 scheme will also ensure that the TMV fitted is suitable to meet the requirements of the Scottish Building Regulations and the government building regulations in the UK for hot water safety.

Type 2 Approval

Products certified as Type 2 approved meet the performance requirements of the relevant standards (BS EN 1111 and/or 1287) and any additional requirements placed on the product and product documentation by the BuildCert Scheme. Type 2 approved products are suitable for typical domestic applications and housing association applications for able bodied people.

For specific applications where the users (e.g. patients, residents etc.), by virtue of their physical or mental condition, are deemed to be at greater risk of injury in their use of domestic hot water than would be the case for able persons in their own dwelling then best practice is to use Type 3 approved products.

Type 3 Approval

Products certified as Type 3 approved meet the performance requirements of the relevant standards DH performance specifications (D 08) and any additional requirements placed on the product and product documentation by the BuildCert Scheme. TMV3 approved products are required for applications where there is a greater risk of scalding incidents. Typically this is in Hospitals and care establishments but these valves should also be considered for domestic applications if the end user has a disability that could increase the likelihood of scalding. Products are certified to be used in particular applications rather than as a blanket approval.

Products approved to the Type 2 and Type 3 schemes are required to undertake routine independent third party audit tests to maintain their approval status in addition to complete reapproval every five years. Both schemes also demand that products are third party independently demonstrably compliant with the Water Regulations.

All products listed as currently approved under both the Type 2 and Type 3 schemes can be found on the BuildCert website.

Further information on best practice and the suitability of valves for particular applications can be found in the BRE information paper BRE IP 14/03 via the following link http://www.beama.org.uk/resourceLibrary/bre-ip-14-03---preventing-hot-water-scalding-in-bathrooms-using-tmvs.html

Water supply

Having considered all of the cost, aesthetic, control options and mounting options, it should not be forgotten that the TMV chosen also needs to be suitable for use not only for the desired application (bath, bidet, shower or washbasin) but also with the water supply system installed in the home.

Water supply systems typically are either high pressure or low pressure systems. Although in practice some high pressure supplies (typically cold supplies) are mixed with low pressure supplies (typically gravity fed hot supplies) these systems are not considered best practice and in particular, for supplies to TMVs nominally equal supply pressures are best.

The manufacturer of the TMV will indicate the suitability of the product for use on high and or low pressure systems. This information is also available on the BuildCert website if the TMV is either TMV2 or TMV3 approved. Both high and low pressure products are only suitable for installation on systems with a maximum 10 bar static pressure. The limits of dynamic (flow) pressure range for low pressure systems is 0.1 to 1.0 bar with the recommended dynamic pressures being within the range 0.2 to 1.0 bar. The limits of dynamic pressure range for high pressure systems is 0.5 to 5.0 bar with the recommended dynamic pressures being within the range 1.0 to 5.0 bar.

Further information can be found in the Generic Industry Guide on Domestic Water Systems available to download from www.bathroom-academy.co.uk

Water efficiency

Water is a finite resource and as such, there is now an increasing awareness on the efficient use of water. This is a message actively being promoted by Government, water companies and various interested parties. The BMA has responded positively to this situation and designed and developed the European Water Labelling Scheme www.europeanwaterlabel.eu

The scheme aims to raise awareness of bathroom products that if installed and used correctly will use less water while still delivering the bathing experience that the consumer has come to expect. The key to water saving is to reduce waste and not to restrict use.

For TMVs there are a number of things that can be done to ensure that the products use water efficiently.

Correct selection of product

TMVs, when selected, should be matched to the intended supply system. This is key to ensuring the safety functioning works correctly, minimising water waste and to gain optimum performance from the product.

If a valve designed only to be used on high pressure systems is fitted to a low pressure system then there may not be enough 'energy' in the water pressure to drive the mechanism. This can result in no or low flow rates but more importantly there is a danger that the TMV will not be able to provide safety in the event of a water supply failure thus not being able to prevent a scalding incident.

If a valve designed only for low pressure installations is fitted to a high pressure system then the mechanism within the valve may not be robust enough to deal with the pressures from the high pressure system to adequately control water temperature. This may result in the valve being unable to provide safety in the event of a water supply failure thus not being able to prevent a scalding incident. In addition to this, excessive flow rates may be encountered during normal use as the flow pathways inside a TMV designed for low pressure systems are larger than those designed for high pressure systems thus resulting in wasted water.

Many manufacturers now produce TMVs that are suitable for both high and low pressure water supply systems. Typically this may need the fitting of flow restrictors or flow regulators to control the flow through the valve at high pressure.

Flow regulators

Flow regulators can be placed in the inlets to the valve (one for the hot supply and one for the cold supply), or on the outlet of the TMV (only one required in this case). Alternatively, they are sometimes placed in the hose or shower head of shower TMVs. While flow regulators are relatively simple devices, care should be taken to ensure they are correctly fitted and they should not be removed (unless specifically directed to do so in the product installation requirements) as they may be an integral part of the safety functioning aspects of the TMV.

Spray plate design

As manufacturers produce TMVs, in particular showers, for use on both high and low pressure systems care must be taken to ensure the correct fitting of the spray plate on the shower head. Shower heads are often supplied with a 'low capacity' and 'high capacity' spray plate to ensure that the delivery of water to the user is optimised. These spray plates have a varying number and size of holes to maximise the performance of the spray. If the high capacity plate is fitted to a shower installed on a low pressure system then the volume of water delivered may be increased but the performance of the spray to the end user will be poor.

As previously mentioned, the selected TMV must be designed to fit with the water supply system it is intended to be used with. In addition to this some thought must be put into the correct location of the TMV to ensure that it can do its job effectively.

Section 4

Installing, Commissioning and Maintenance

General

TMVs have a hot and a cold water supply connection. If the water supplies are not installed to the correct connection then the mixing valve will not work correctly. This could manifest itself by no flow coming through the TMV or it could initially appear to work correctly. This is of course an extremely dangerous situation, as when a water supply has failed the safety function of the valve will not operate correctly.

Most TMVs are fitted with strainers to help maintain the efficiency of the mechanism between service intervals. However, all installation pipework must be flushed through prior to the connection of any TMV. Failure to do this may cause debris, flux or grease to be carried into the mechanism of the TMV.

It is good practice to install service valves on each supply as close as possible to the TMV to ensure that the TMV can be adequately serviced. Some TMVs are supplied complete with integral service valves however, this does not obviate the need to fit a service valve on the actual supply pipes themselves.

‘T’ Pattern TMVs

These are usually located beneath basins, bidets or baths and may be used to supply one or more outlets. Care must be taken to ensure that the dead leg between TMV outlet and terminal fitting is kept to a minimum distance. Typically this should not be any longer than 2 metres. There are a number of reasons for this – to minimise wasted water as longer dead legs mean more water is drawn off before the controlled temperature is reached and to ensure that water quality is not compromised by providing a warm environment in which bacteria can easily breed.

The outlet from the ‘T’ pattern TMV will need to be paired with either a pillar tap or single lever mixer tap or mechanical mixing valve shower as necessary for the intended application.

Showers

Correct location of the shower valve will obviously depend upon the specifics of the shower enclosure or bath that it is fitted in. Typically the pipework is concealed and thus careful planning is required to ensure that the pipework matches the inlet centres of the TMV. Connection centres of an exposed shower TMV are typically 150 ±1mm or 153 ±1mm connections (compatible to 6” centres). Connection to a built in valve is obviously more involved and typically the dimensions for these valves have less commonality. If fitting into a solid wall, the wall will need to be chased out to allow the valve to sit within the wall to the correct depth, receive the water supply pipes and also allow for a connection to either a concealed rigid riser or a right angled connection for a flexible shower hose.

Consideration must also be made to ensure that any flexible hose and handset installation is installed to meet any backflow prevention requirements.

Bath Shower Mixers

These devices are typically either deck mounted to the rim of a bath or tiled surround, or wall mounted. As with shower valves due care should be taken to ensure that any flexible hose and handset installation is installed to meet any backflow prevention requirements.

Taps

As with BSMs these are typically deck or wall mounted.

The incoming water supplies should conform to pressure and temperature limitations of the TMV being installed and also be in line with any other requirements such as that for Type 3 installations.

Commissioning

Having installed the TMV it must be commissioned to ensure that the maximum temperature of mixed water delivered is not too hot to cause scalding.

Typical maximum set temperatures are:-

Bidet	38°C
Washbasin	41°C
Shower	41°C
Bath	44°C

Each manufacturer will provide clear documentation detailing how to set the maximum mixed water temperature and to ensure that the TMV is capable with situations such as the effect of secondary draw offs from the same water supply eg cold water supply pipe to a TMV also being used for WC flushing.

The set mixed water temperature will require a temperature differential between it and the temperature of either supply. This is typically 10°C but the manufacturers’ instructions must be consulted to ensure that the minimum differential is set. Failure to set the mixed water with the correct differential will compromise the efficiency of the safety function of the TMV.

Maintenance

All manufacturers stipulate a service and maintenance schedule for TMVs. It is necessary to follow the details to maintain the correct functioning of the TMV. Failure to maintain a TMV could result in the product failing to prevent a scald occurring.

Typical maintenance regimes will call for the strainers to be checked and cleaned as necessary and to verify the operation of the check valves. In addition, it may be necessary to replace seals and to re-grease the internal mechanism. Mixed water temperatures should be checked to ensure that the TMV is correctly set up for the intended end user. A cold water supply isolation test should be performed to validate that the TMV is capable of adequately controlling the hot water discharge in the event of loss of the cold water supply.

Section 5
Common Fault Diagnosis

Most common problems that occur with TMV installations can be resolved by conducting a few simple checks:

No water flow
- Have the supplies been turned on to the TMV?
- Is there enough pressure?
- Have the inlet connectors and strainers been checked for blockages?
- Is there an air lock in the hot or cold supply?

Water too cool
- Is the hot water supply hot enough? This should be at least 55 - 60°C.
- Has the TMV been correctly connected to low pressure hot and cold? If mains cold water is connected then re-connect the cold supply from the cold water storage cistern to the TMV.
- Is the hot supply from a combination boiler? If the selected flow rate is too low then the combination boiler may not be able to ‘fire-up’ thus not producing any hot water.
- Has the TMV maximum mixed water temperature been set correctly for the incoming water supply temperature?

Water too hot
- Is the cold water isolating valve fully open?
- Has the cold inlet been checked for blockages?
- Has the TMV maximum mixed water temperature been set correctly for the incoming water supply temperature?
- Is the hot water supply too hot? TMVs should not be supplied with water in excess of 80°C as internal component damage may occur.

Poor flow
- For showers - has the spray plate been de-scaled?
- Are isolating valves fully open?
- Is the TMV designed to be used with the water supply system to which it is fitted?
- Are flow regulators incorrectly fitted or blocked?
- Is there enough pressure?
- Is there an air lock in the hot or cold supply?

Section 6

Frequently Asked Questions

Why should I install a TMV?

A TMV can be used to control the maximum hot water temperature available at a hot tap outlet or shower outlet thus significantly reducing the possibility of scalding the end user. A TMV therefore offers the most cost effective solution to reduce the risks of scalding in the bathroom environment.

What type of TMV do I need to fit and why?

Typically in domestic situations a valve that complies with BS EN 1111 and/or BS EN 1287 or indeed has been certified as TMV2 approved is suitable. These TMVs are aimed at providing suitable safety for the average able bodied person in the home. A wide variety of products is available to meet the specific needs of the application.

If the end user could be categorised as less able by virtue of a physical or mental condition and are therefore deemed to be at greater risk of injury in their use of domestic hot water than would be the case for an able bodied person, then a TMV that complies with either BS 7942 or DH D 08 or a TMV that is TMV3 approved should be used.

Can I install a TMV with unequal pressures?

In short – yes. However, care should be taken to check the manufacturers' information regarding the ability of the valve to cope with unequal pressures. Many manufacturers will quote the maximum amount of imbalance as a ratio (e.g. 10:1 – this literally means that the valve will work with one pressure being up to 10 times greater than the other pressure). It is important that any TMV is installed with check valves (if they are not an integral part of the TMV) where an imbalance of pressure exists as the check valves will prevent crossflow. It is also worth noting that where one supply is high pressure (typically the cold) and the other supply is low pressure a better solution would be to reduce the high pressure to a lower value (by use of a pressure reducing valve) to nominally equalise the pressures. Flow rates may be affected due to this, so the closer the working parameters the better.

Will fitting a TMV affect the flow rate?

The fitting of any control device to a water supply will affect the flow rate. However, on high pressure systems any effect on flow rate should be negligible. The situation on low pressure systems can be somewhat different. This is especially true if a TMV designed for high pressure systems is fitted to a low pressure supply. The flow paths through the valve may not be big enough to allow adequate water flow. For TMVs designed to be used on low pressure systems, the water flow may still be affected but this will be dependent on the amount of 'head' between the outlet of the valve and the water supply cisterns; 1 metre of 'head' equates to approximately 0.1 bar of pressure.

Most TMVs have a recommended dynamic supply pressure requirement of 0.2 bar (equating to 2 metre head). For shower TMVs while there may be 2 metres between the actual valve part and the cistern there may actually only be 1 metre between the shower head and cistern and this will be the limiting factor on the flow rate.

Can I use a TMV with a combination boiler?

TMVs are suitable for use with combi boilers as long as the boiler is a fully modulating type (i.e. the gas flame is regulated in sympathy to the flow of water through the heat exchanger). If the combi is not a fully modulating type the TMV will not be able to maintain a stable outlet temperature. This is due to hot water from the non-modulating boiler increasing in temperature as it enters the TMV, the TMV will reduce the amount of hot water it mixes with cold water to try to maintain the stable set temperature. In turn, the flow through the boiler is reduced to the point where a thermostat within the boiler switches off the gas burner. The water temperature from the boiler will then reduce until the boiler thermostat resets thus allowing the water flow to be heated again. This results in the outlet from the boiler and also therefore from the TMV, to constantly cycle between hot and cool temperatures.

Section 7

Industry Terminology

Airlock
Section of pipework that, due to its layout, enables a pocket of air to become trapped. This results in zero or very little water flow through the pipe.

Backflow
A flow through the pipe in a direction contrary to the intended direction of flow.

Back Siphonage
A backflow caused by the siphonage of liquid from a cistern or appliance into the pipe feeding it, possibly leading to a contamination of the water supply.

Bar
A unit of pressure measurement commonly used for water systems. 1 bar is approximately equivalent to a column of water 10m high or 14.5lbf/in or 100 kPa.

Built In
A valve or fitting where the body is built in to the wall.

Check Valve
A plumbing fitting designed to allow water to flow in only one direction.

Cistern
A fixed container for holding water at atmospheric pressure. It is normally fitted with a float operated valve and warning pipe or a no less efficient device.

Cold Water Storage Cistern
A fixed container for holding water at atmospheric pressure usually used for providing a feed to a vented domestic hot water cylinder. It can also be used to provide a vented cold supply to water fittings.

Concealed
See Built In.

Cross Flow
The water flow from one side of a hot/cold mixer to the other, possibly leading to a contamination of the water supply.

Diverter
A device used to control the direction of water flow to an alternative/various outlet(s).

Double Check Valve
Two check valves in series.

Dynamic Pressure
The water pressure in the pipework to a fitting or valve under flow is taking place.

Exposed
A valve or fitting where the body is mounted on a wall surface.

Float Operated Valve
Valve used to control the flow of water into a cistern, the valve being controlled by the level of water in the cistern.

Flow
The volume of water moving through a given point, normally expressed in litres per minute, gallons per hour or metres cubed.

Flow Limiter
See Flow Regulator.

Flow Pressure
See Dynamic Pressure.

Flow Regulator
A device with moving parts which responds to variable inlet pressures to control flow at a reasonably constant rate. These are subdivided into two types:

- Fixed – manufactured in a range of predetermined flow rate settings.
- Variable – manually adjustable to provide different flow rate settings.

Flow Restrictor
A device with no moving parts which restricts flow. Unlike a flow regulator, it does not keep a constant flow when the supply pressure varies.

Handset
See Hand Shower.

Handset Holder
A fixed device for holding a handset.

Hand Shower
A shower head attached to a flexible shower hose also termed a shower handset.

Head
Refers to the height of a water supply/storage cistern above a TMV or showerhead.

High Pressure
Reference to dynamic water supplies in the pressure range 1.0 to 5.0 bar.

Hose Restrainer
A device through which a shower hose passes to prevent back siphonage.

Hose Retaining Ring
See Hose Restrainer.

Low Pressure
Reference to dynamic water supplies in the pressure range 0.2 to 1.0 bar.

Maintained Pressure
See Dynamic Pressure.

Manual Mixing Valve
A device which does not compensate for variations in the pressure or temperature of the incoming water supplies and needs to be adjusted manually.

Non Return Valve
See Check Valve.

Parking Bracket
See Wall Bracket.

Pressure Reducing Valve
A valve which reduces the pressure in a supply line from a high upstream pressure to a lower downstream pressure under both flow and no flow conditions.

Recessed
See Built In.

Right Angled Connector
Wall mounted device to enable a flexible shower hose to be connected to a concealed outlet from a Built In valve.

Rigid Riser
Solid pipe conveying water from the mixing valve/shower controls to the shower head. A rigid riser can be either exposed or concealed into the wall. Where this is exposed the finish on the pipe is often chrome plated to match the finish on the existing valves/shower control.

Riser Rail
See Wall Bar.

Servicing Valve
A valve for shutting off the flow of water in a pipe connected to a water fitting to facilitate the maintenance or servicing of that fitting.

Shower Head
Any device designed to produce a spray pattern.

Shower Hose
A flexible pipe that connects between the shower head outlet and the shower control.

Slide Bar
A vertical rail assembly to allow height adjustment of a handset holder.

Static Pressure
The water pressure existing at a fitting with no flow taking place.

Standing Pressure
See Static Pressure.

Storage Cistern
A cistern, other than a flushing cistern, that is used to store water for subsequent use.

Strainer (Filter)
A screen to prevent debris from entering a water fitting.

Supply Pipe
A pipe conveying mains cold water around a building.

Supply Stop Valve
A valve used to isolate the mains cold water supply within a building.

Thermostat
A temperature sensitive device that produces a movement to control outlet temperatures in thermostatic mixing valves.

Thermostatic Mixing Valve
A device to compensate for variations in the incoming water supplies, to maintain a selected blend temperature.

Type 1
A mechanical mixing valve, or tap with maximum temperature stop where appropriate.

Type 2
A thermostatic mixing valve, generally complying with BS EN 1111 and/or BS EN 1287 with maximum temperature stop.

Type 3
A thermostatic mixing valve with enhanced thermal performance complying with DH (D 08).

Unvented Domestic Hot Water System
A plumbing system where the cold feed is taken directly from the mains to provide a high pressure hot water supply. There is no open vent to atmosphere.

Wall Bar
See Slide Bar.

Wall Bracket
Fixed device for holding a handset.

Wall Outlet
See Right Angled Connector.

Section 8

References

Water Supply (Water Fittings) Regulations 1999

The water fittings regulations (or byelaws 2000 in Scotland) are national requirements for the design, installation and maintenance of plumbing systems, water fittings and water using appliances. Their purpose is to prevent misuse, waste, undue consumption, contamination and erroneous measurement of water and, most importantly, to prevent contamination of the drinking water supply. They replace the former Water Byelaws which each water supplier had administered for similar purposes for many years.
www.legislation.gov.uk/uksi/1999/1148/contents/made

Building Regulations

Communities and Local Government are responsible for building regulations, which exist to ensure the health and safety of people in and around buildings, and the energy efficiency of buildings. The regulations apply to most new buildings and many alterations of existing buildings in England and Wales, whether domestic, commercial or industrial. General public users and professional users can access building regulations guidance, including the Approved Documents and associated guidance from the Planning Portal at: www.planningportal.gov.uk/buildingregulations/approveddocuments

BS 8558:2011

Guide to the design, installation, testing, and maintenance of services supplying water for domestic use within buildings and their curtilages. Complimentary guidance to BS EN 806.

BS EN 1111:1999

General Technical Specification for thermostatic mixing valves for use in high pressure systems. Forms the basis of BuildCert TMV2 approval for high pressure TMVs.

BS EN 1287:1999

General Technical Specification for thermostatic mixing valves for use in low pressure systems. Forms the basis of BuildCert TMV2 approval for low pressure TMVs.

BS 7942:2011

Thermostatic mixing valves for use in care establishments.

BS EN 1112:2008

Sanitary tapware. Shower outlets for sanitary tapware for water supply systems type 1 and type 2. General technical specification.

BS EN 1113:2008+A1:2011

Sanitary tapware. Shower hoses for sanitary tapware for water supply systems type 1 and 2. General technical specification.

Department of Heath Performance Specification D 08

Specifies the performance, material requirements and test methods for thermostatic mixing valves for use in care establishments. Is referenced in many other DH documents. Forms the basis for BuildCert TMV3 approval.

BuildCert

Independent third party approval body responsible for the running of the TMV2 and TMV3 approval schemes. It accepts results from various test houses accredited to ISO 17025.
www.wrcnsf.com

Water Regulations Advisory Scheme (WRAS)

Approval body responsible for the running of the WRAS approval scheme that certifies product complying with the Water Regulations. It accepts results from various test houses accredited to ISO 17025.
http://www.wras.co.uk

KIWA UK

Third party independent test house and approval body that undertakes testing to ISO 17025 for fittings for KIWA UK approval (compliance to Water Regulations), WRAS approval and BuildCert Approval.
http://www.kiwa.co.uk

NSF-WRc

Third party independent test house that undertakes testing to ISO 17025 for fittings for WRAS approval and BuildCert Approval.
www.wrcnsf.com/

BS EN ISO 17025:2005

General requirements for the competence of testing and calibration laboratories.

BRE IP 14/2003 ISBN

This document provides guidance on the best practice and the suitability of thermostatic mixing valves for the intended application and includes details of legal requirements of particular types of installations.
www.bre.co.uk

The Bathroom Manufacturers Association (BMA)

The trade association that represents the major manufacturers of bathroom products, ranging from sanitaryware, baths, taps, showers, enclosures, accessories and furniture. Members of the BMA offer products with an outstanding combination of quality, style, design, colour and availability.
www.bathroom-association.org

Contact details for plumbing organisations

Scottish and Northern Ireland Plumbing Employers Federation (SNIPEF) is the trade association representing businesses involved in the installation and maintenance of plumbing and heating systems. For a list of members telephone 0131 556 0600, or visit the website www.snipef.org

The Association of Plumbing & Heating Contractors (APHC) is the leading trade association for the plumbing & heating industry in England & Wales. For a list of members telephone 0121-711 5030 or visit the website www.aphc.co.uk

The Institute of Plumbing and Heating Engineering (IPHE) is the professional body for the UK plumbing industry. For a list of members telephone 01708 472791, or visit the web site www.ciphe.org.uk

NTG – Telephone 0115 921 4865. Website www.kbbntg.org.

CITB – Website www.citb.co.uk