Student Study Section

A brief introduction to Thermostatic Mixing Valves

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The Problem

The highest number of scalds resulting in death or severe injuries is caused by hot bath water. The people most at risk are the very young and the elderly, due to their slower reactions and thinner skin. If a young child is scalded they may be subject to many years of painful skin grafts surgery and their carers can be subject to deep feelings of guilt and remorse. However, if an elderly person is scalded in a bath they are about 10 times more likely to die as a result.

Scalding

Scalds are burns caused by hot liquids. The severity of the scald is expressed on a simple three step scale in terms of degrees.

A third-degree burn means the entire thickness of the skin is destroyed and the wound has to be surgically removed and the area covered with a skin graft.

A second-degree burn is a burn with blisters and with proper treatment many of these will go on to healing without a skin graft.

A first-degree burn would be like a superficial sunburn where there is no blistering.

Hot water temperatures

Scalds result from a combination of water temperature and duration of exposure, or immersion. At high temperatures scalds can result almost instantaneously, however, at low temperatures, in the high 40s, if the duration is sufficient scalds can occur. As the temperature of the water increases above 50°C, the duration of exposure needed to suffer third-degree burns decreases rapidly.

Healthy adult skin requires 30 seconds of exposure to water at 54°C – 55°C before third-degree burning occurs, but only 5 seconds at 60°C and less than one second at 70°C. However, the skin of children and the elderly is even more sensitive to extreme temperatures. Hence, such scalds could occur at temperatures around 10°C lower for these more vulnerable people.

Preventing scalds

Simply reducing the set outlet temperature of baths and showers is one solution that has been adopted in some counties. However, such an approach can result in different problems. Usually, temperatures in excess of 60°C are used in storage cylinders to combat Legionella and hot water systems are often designed to deliver water at 50°C.

There are alternative methods to thermal control that can be used to control Legionella, but thermal control is currently the most common. A more detailed discussion of Legionella will be found in the forthcoming IPHE 'Combating Legionnaires Disease – An application and treatments guide'.

Maximum outlet temperatures are a debatable topic and many experts hold diverse views; however, here are the TMV2 agreed maximum discharge temperatures:

- Temperatures should never exceed 46°C
- 38°C for bidets;
- 41°C for showers;
- 41°C for washbasins;
- 46°C for bath fill.

It is important to note that **46°C** is the maximum temperature for water from the bath hot tap, having regard in particular for the margin of error inherent in TMV2 valves and temperature loss in metal baths, especially in cold bathrooms. **It is not a safe bathing temperature for adults or children.**

The British Burns Association recommends **37 to 37.5°C** as a comfortable bathing temperature **for children**. In premises covered by the Care Standards Act 2000, the maximum water outlet temperature is specified as **43°C**.

TMVs (see also www.iphe.org.uk - Technical Talk section)

One of the most established methods to limit temperature discharge is to use thermostatic mixing valves (TMVs). Although such valves have been available for decades, it is only through recent developments that valves with lower maintenance requirements have become readily available. For many years TMVs have been specified in healthcare establishments. These valves were constructed to specification known as D08 [Model engineering specifications D08 Thermostatic mixing valves (healthcare premises), NHS Estates, 1997] and when Certified by BuidCert to a TMV scheme specification were designated TMV3 valves.

Part of the Certification included regular in-situ testing of the valves dependant upon its individual history. This usually resulted in testing about twice a year.

Such a rigorous testing regime was not suitable for domestic situations so an alternative scheme was developed for TMVs made to a different specification. The TMV2 scheme currently only requires testing once a year. The development of TMV2 valves has enabled a wider application of TMVs. For example, the new Scheme Development Standards from the Housing Corporation now include a recommendation to fit thermostatic control to bath taps.

Thermostatic control could simply be defined as a mechanism that will maintain temperature precisely at a preset value. However, even with the best technology currently available such a control is impossible. There will always be some circumstances where constant temperature can not be maintained. Hence, actual thermostatic control allows a number of tolerances on the various

thermostatic parameters.

Thermostatic parameters normally include:

- hysteresis,
- speed of response,
- reliability,
- shut-down,
- pressure variation

All TMVs have different operating specifications due to their designs, so it is very important to use an appropriate thermostatic control for an application. TMVs are not always appropriate devices to control water temperatures.

- A TMV that is approved for **low** pressure can be used where dynamic pressures are in the range of **0.2 to 1 bar**.
- A TMV that is approved for **high** pressures can be used where dynamic pressures are in the range of **1 to 5 bar.**
- A valve which is approved for **both** high and low pressures can be used for high and low pressures in the range of **0.2 to 5 bar.**

Although there are both 'High pressure' TMVs (EN 1111) and 'Low pressure' TMVs (EN 1287), TMVs will not work in many of the current traditional plumbing systems as a minimum pressure of 0.2Bar is needed for reliable operation of Low pressure TMVs. Alternatives to TMVs in very low pressure situations include temperature limited valves in which simple physical stops are used to limit the rotation of the temperature selector.

How to install TMVs

Before installing the thermostatic valve to a washbasin, shower or bath, ensure that the specification of the valve is appropriate for the application i.e. flowrates, pressures and water temperatures must be within the limits stated by the manufacturer, hence it is vital to read the manufacturers' instructions. Most valves can be installed in any orientation provided that the hot and cold supplies are connected to the appropriate inlets. Check the information supplied with the TMV for space requirements for your installation.

Some TMV's incorporate isolating valves and full bore strainers in their design. It is highly recommended that full bore strainers are installed on the hot and cold inlets. Strainers must be located in a position where they can be readily accessed for servicing. Isolating valves must be installed on the hot and cold supplies leading up to the valve. The thermostatic mixing valve itself must be fitted in such a way that testing and if required servicing, can be carried out without major renovation works being undertaken.

Thermostatic mixing valves contain temperature sensitive components therefore soldering near the main valve body must be avoided.

Although it may be physically possible to use one TMV to control the temperature of the hot water supply to all the appliances in an enclosed space, such as a bathroom, this is **not** recommended because:

- It is likely that runs of pipework from the TMV to the outlets would exceed the recommended 2 metre limit,
- The TMV2 guidance gives maximum temperatures for each appliance, for a bath 46°C and for a basin 41°C,
- if one TMV is used to supply both either the bath would be too cold or the basin too hot.

Commissioning and adjusting a TMV

During commissioning of a TMV read the instructions and check:

- The designation of the thermostatic mixing valve matches the application.
- The supply pressures are within the valve's operating range and differential ratio.
- The supply temperatures are within the valve's operating range.
- The temperature of the hot water being supplied to the valve is higher than the desired mixed water outlet temperature.
- Isolating valves and strainers are provided.
- If the installation is acceptable the water temperature can be set.
- Set the temperature as laid out in the manufacturer's instructions.
- Temperature readings should be taken at the normal flowrate after allowing, about a minute, for system to stabilise.
- Such a requirement is not always easy to carry out due to diverse water spray patterns and the limitations of temperature measuring equipment. It is important that:
- The sensing part of the thermometer probe must be fully submerged in the water that is to be tested.
- Any TMV that has been adjusted or serviced must be recommissioned and re-tested in accordance with the manufacturer's instructions.

Maintaining the TMV

TMV2 valves should be tested annually against the original performance results using the following performance checks:

- Measure the mixed water temperature.
- Carry out the cold failsafe shut-off test by isolating the cold water supply to the TMV. Wait for five seconds; if water is still flowing, check that the temperature is below 46°C.
- If there is no significant change to the set outlet