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# Summary Bulletin
# Regulatory Requirements for Controlling Water Temperature in Bathrooms

PEER REVIEWED

Authored by
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Authored by Phillippa Carnemolla and Catherine Bridge for the Home Modification Information Clearinghouse, UNSW Australia


# Abstract

This Summary Bulletin relates to the safe provision of heated water in the people's bathrooms for washing and bathing through the installation of temperature limiting devices. A number of regulations and requirements are in place around the storage and delivery of heated water in a residential setting because of two public health concerns: the risk of scald burns in water delivered too hot and the risk of microbial presence (particularly legionella) in heated water stored at temperatures too low. An analysis of Australian Standards and regulations indicate that temperature limiting device options for use in people's homes include: thermo-static mixing valve, tempering valve, or a hot water system compliant with *AS 3498*.



# Keywords

bathroom modification; hot water; plumbing; water temperature; thermostatic regulation



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## Publication History

1st edition Thermostatic Mixing Valves by Julie Cameron and Catherine Bridge, 2004

## Contribution of Authors

This is the Second Edition of the Summary Bulletin: Temperature Limiting Devices in Hot Water, replacing the original publication, titled Thermostatic Mixing Valves. This edition updates compliance regulations which have been superseded since first publication. In the twelve years since this first edition there have been considerable changes and additions to relevant codes. The First edition was authored by Julie Cameron and Catherine Bridge (2004), for the Home Modification Information Clearinghouse, UNSW Australia.

In this 2nd edition, Phillippa Carnemolla updated all references to regulatory codes, restructured the report and added information about maintenance and assessment. Catherine Bridge contributed to the draft report .

Product illustrations have been drawn by Michelle Svenger and diagrams by Phillippa Carnemolla.

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The overall structure of the report has been retained from Edition 1, with the inclusion of further tables and detailed information about compliance, maintenance requirements and design solutions. HMinfo have a policy of undertaking a review process prior to the publication of research documents. The reviews are performed by Specialist Review Panels in accordance with the HMinfo Specialist Review Panel: Terms of Reference, available at www.homemods.info.

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# Glossary

**End of line device** A device where one end (the outlet) is open to atmosphere and allows water to flow out and the water can then be used by a person (e.g. tap).

**Legionella** A gram-negative aerobic bacteria that can lead to Legionnaires' disease . Legionnaires' disease is a lung infection that is fatal for about one in 10 persons who become infected.

**Temperature Limiting Device** A device that limits the outlet water temperature to a pre-determined maximum temperature. An example of this device is a Tempering Valve or Thermostatic Mixing Valve.The temperature of the mixed water is preset at the valve during installation and cannot be controlled by the user.

**Tempering Valve** A mixing valve that is temperature actuated used to temper a hot water supply with cold water to provide hot water at a lower temperature at one or more outlet fixtures

**Thermostatic Mixing Valve (TMV)** A mixing valve where temperature of the water from the mixed water outlet is automatically controlled by a thermostatic element/ sensor to a preselected temperature that is suitable for direct contact with the skin. A TMV can also service more than one outlet within the manufacturers specified operating flowrate range. This flowrate determines the number of devices that can be serviced by the valve simultaneously

**Thermostatic Mixer (also known as a Thermostatic Mixing Tap and Thermostatic 'Point of Use' Mixers)** A 'point of use' thermostatically controlled mixer that resembles a tap (end of line device) into which separate hot & cold water supplies are mixed and delivered to a user. It has adjustable flowrate and temperature however the temperature is limited by an internal, integrated thermostatic element, which can be preset to maximum temperature that is suitable for direct contact with the skin.

**WaterMark Certification Scheme** The WaterMark Certification Scheme (WMCS) is a mandatory certification scheme for plumbing and drainage materials and products to ensure they are fit for purpose and appropriately authorised for use in plumbing and drainage installations. The WMCS is managed and administered by the Australian Building Codes Board.


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# Background

This Summary Bulletin relates to the safe provision of heated water in peoples' bathrooms for washing and bathing through the installation of Temperature Limiting Devices (TLD). A number of regulations and requirements are in place around the storage and delivery of heated water in a residential setting because of two public health concerns: the risk of scald burns from water that is delivered too hot and the risk of microbial presence, particularly legionella, in heated water stored at temperatures too low.

## The need for temperature regulation in household water storage and delivery

The delivery temperature of water in a bathroom can become hazardous at both hot and cold extremes. Injuries related to fluctuation in water temperature include scalding and thermal shock. A scald is a burn caused by hot liquids or steam including heated tap water. Thermal shock is "*a rapid and uncomfortable change in water temperature causing an abrupt physical reaction of a person*" (Viola, 2002 p.1). Scalds from hot tap water can result in serious injuries particularly when the scald occurs in the bath and shower. Due to the nature of the activity, scalds from baths or showers often cause burns over an extensive body surface area with opportunity for a high proportion of full thickness burns. Consequently an extended recovery period with long-term medical care is common; the result is significant financial and social costs.

Children, older people and people with a disability are particularly at risk of scald burns. More than 400 older people were treated for burn or scald injuries in Victoria from 2001–2003 with six deaths attributed to hot tap water scalds. A study of a US burns unit by Stone, Ahmed and Evans (2000) found that older people 65 years and older) comprised 15% of all burns and noted that bath injuries (usually burning a large surface area) cause half of the scalds to older people

For people with dementia, the risk of scald burns is even more elevated. A recent Australian study found that people with dementia were more likely to be burnt by hot tap water, and were 60% more likely to be hospitalised for their burns (Harvey, Mitchell, Brodaty, Draper, Close, 2016).

Temperature limiting devices that limit the period of exposure to high water temperatures increase the response time available before serious injury occurs. In Australian research, Cassell, Clapperton & Ashby (2004) noted that the implementation of maximum temperature regulations in 1994 is contributing to a reduction in severe scald injuries. More recent international research by Clouatre, Pinto, Banfield and Jeshke (2013) support these claims, however hot water scald accidents remain a significant public health concern.

The severe burns (full thickness burns) occur more quickly at higher temperatures as shown in Table 1. Table 1 below indicates the time taken for a full thickness burn to develop at varying water temperatures.

**Table 1: Relationship between water temperature and time to develop full thickness burn**


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| Delivered hot water temperature | Approximate time to cause a full thickness burn |
|---|---|
| 70°C | Less than 0.5 seconds |
| 60°C | 1-5 seconds |
| 55°C | 17-30 seconds |
| 50°C | 2-8 minutes |
| 45°C | 2-3 hours |

The minimum allowable stored water temperature average temperature in private dwellings in Australia is 60°C. Mains pressure storage water heaters may have preset or adjustable themostats from 60°C-70°C. Average heated water delivery is understood to be approximately 65°C. Water at 65°C can severely burn in less than half a second. Authorities and regulations state the ideal maximum, safe delivery temperature for hot tap water is 50°C. At 50°C it takes five minutes to cause a full thickness burn. The likelihood and severity of burns increases with small increases in water temperature. Implementing strategies that decrease the delivery temperature of water increases the time before a full thickness burn occurs. As children and older people have thinner skin, they are particularly vulnerable to accidental burns and scalds from hot water and may be seriously burned by heated tap water in less time than other people in the population.

## Risks of low temperatures in water delivery

In addition to the risks associated with water that is delivered in a bathroom too hot, it is important to be aware of the risks of exposure to low water temperatures. Water delivery temperature that is too low may contribute to hypothermia, low core body temperature. Hypothermia commonly occurs from exposure to cold water or air over an extended period. People who have compromised body temperature regulation are at risk of undetected reduction in the core body temperature. The symptoms of mild hypothermia can easily be overlooked or misinterpreted. Symptoms include increased heart rate, slight incoordination in hand movements, increased respiratory rate and shivering. As the body temperature falls muscle incoordination and weakness increases, confusion may occur and shivering may decrease or cease leading to a risk of muscle spasm, hyperventilation, cardiac arrest or falls.

In a bathroom environment, thermal shock is potentially hazardous because of the increased risk of falls associated with an abrupt movement. Large areas of the body are exposed to the water while showering. Sudden movement to avoid the discomfort of the change in water temperature on a slippery floor and in a confined space increases the risk of severe injury in the event of a fall. The risk of fall due to thermal shock is greater for people with mobility impairment or compromised balance, including older people and people with a disability


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In addition to exposure to cold water or air, factors that contribute to low body temperature include low blood pressure, some medications and low blood sugar. Exposure of people with these factors to cold water or air may further increase the risk of hypothermia. Due to the longer periods that people with a disability and older people may be naked and wet under the shower, consideration should be given to the increased risk of mild hypothermia. The risk of hypothermia must be assessed for each individual. Where the individual is identified as 'at risk' water delivery temperature should be sufficiently warm to minimize hypothermic risk and cool enough to avoid scalding.

## Microbial risk of low temperatures in water storage

In any water stored for periods of time, such as in heated and warm water tanks, there is the risk of microbial growth which can cause disease and death. Of significant public health concern is the Legionella bacteria which can lead to Legionnaires Disease or Pontiac Fever (see Figure 1). Although legionella has been more prevalent in commercial water cooling, the recognition of Legionella within water delivery systems is on the increase globally as more and more cases are reported (Garrison, Kunz, Cooley, 2016). Historically these have related to higher risk applications such as in healthcare however there are also reported incidents in aged care and private homes. In South Australia a man died in October 2014 after contracting Legionnaires Disease from his home hot water system (Dowdell, 2014). In 2013 another man died in a South Australian aged care facility and a protracted legal battle continues (Crouch, 2015).

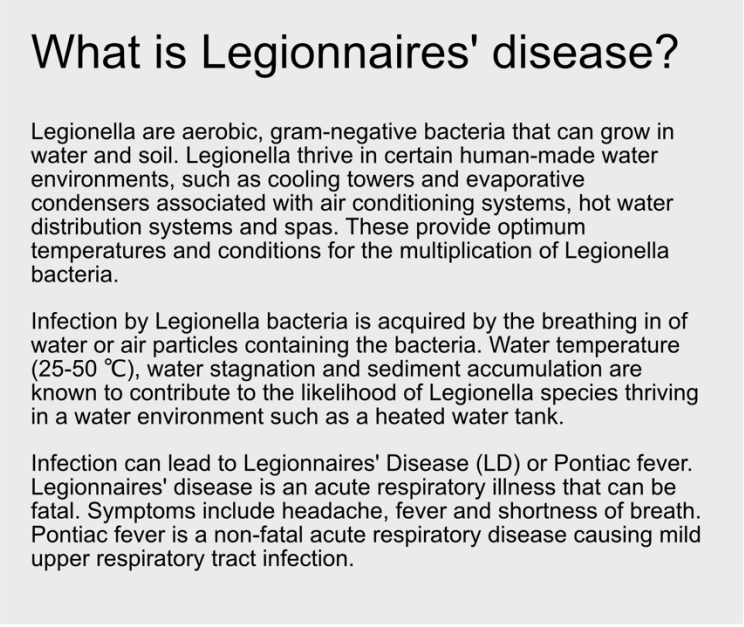


**Figure 1: Explanation of the relationship between Legionella bacteria and Legionnaires' disease level**

**Source:** Adapted from World Health Organisation (2011) Guidelines for Drinking-Water Quality and Workplace Health and Safety Queensland (2013) Guide To Legionella Control In Cooling Water Systems, Including Cooling Towers.


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Heated water stored at lower temperatures (less than 60°C) is at increased risk of bacterial growth. Legionella bacteria are of particular public health concern and will proliferate in a heated water system if temperatures are favourable (25 - 50°C). To inhibit growth of the Legionella bacteria, the National Construction Code of Australia (NCC) requires that "all heated water must be stored and delivered under conditions which avoid the likelihood of the growth of Legionella bacteria " and refers to Australian Standard (*AS/NZS 3500.4:2015*, Part 4) for performance requirements. *AS/NZS 3500.4:2015* requires minimum stored water temperature of 60°C in new heated water systems (*AS/NZS 3500.4:2015* Part 1.9). In hot water systems where water is stored above 60°C Legionella bacteria will die.

# Regulatory Requirements for Temperature Limiting Devices in the Home

In response to the evidence on public health risks of both stored water temperatures and hot water delivery temperatures, a number of countries, including Australia, have introduced regulations around minimum and maximum temperatures for storage and/or delivery of water. Since the publication of the first edition of this report, Australia's National Construction Code has been published (NCC). The NCC is produced and maintained by the Australian Building Codes Board (ABCB) and is a uniform set of technical provisions for the design and construction of buildings and other structures, and plumbing and drainage systems throughout Australia. Plumbing and drainage systems are covered in Volume 3 of the NCC as the Plumbing Code of Australia (*NCC 2016-PCA*).

The *NCC 2016-PCA* states in section BP2.2 that all new heated water services (i.e. in a new home or renovations) "must be delivered to fixtures and appliances used primarily for personal hygiene at a temperature which reduces the likelihood of scalding." *NCC 2016-PCA* also states in section BP2.5 that "heated water must be stored and delivered under conditions which avoid the likelihood of the growth of Legionella bacteria".

There are a number of commercially available solutions to control the storage and delivery temperature of water. Each of the solutions has strengths and limitations that should be considered in selecting a device. These advantages and disadvantages are provided in Selection Factors.

The latest 2015 revision of *AS 3500.4:2015* makes clear the requirements of what temperatures and in which applications tempering valves or TMVs need to be installed. A condensed version of the information appears in the following paragraphs, however please refer to *AS/NZS 3500.4:2015*, page 10 for full requirements.


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A household heated water installation[1] is deemed to comply with *AS/NZS 3500.4:2015* Water Temperature Clause 1.9.3(b) if all sanitary fixtures used primarily for personal hygiene purposes are supplied from –

- a thermostatic mixing valve complying with *AS 4032.1* and adjusted to an outlet temperature not exceeding 50°C;
- a tempering valve complying with *AS 4032.2* and adjusted to an outlet temperature not exceeding 50°C; or
- a water heater complying with *AS 3498* and marked with the following: THIS APPLIANCE DELIVERS WATER NOT EXCEEDING 50°C IN ACCORDANCE WITH *AS 3498*.

Regulatory advice can vary from state to state in Australia. The NSW Fair Trading Plumbing Industry Technical note 1/2013 (NSW Fair Trading, 2013) outlines that temperature limiting devices MUST be installed when:

- Replacing a hot water heater - regardless of the type of heater or location of the heater.
- When doing new hot water pipe work on an extension, all NEW work is required to be tempered. NOTE: All existing hot water pipe work can remain unchanged.
- When temperature touch pads are being installed. Touch pads are not an approved temperature limiting device.
- Instances where a temperature limiting device is NOT required include:
- When there is a factory pre-set hot water unit being installed that supplies ablution areas (eg: bathrooms). This excludes healthcare and aged care buildings, early childhood centres, primary and secondary schools and nursing homes or similar facilities for the aged, the sick, children or people with disabilities etc. (Refer *to AS/NZS 3500.4:2015* 1.9.2 Sanitary fixtures delivery temperature).
- When doing maintenance only on the valves to a heater (eg: replacing duo valve, control vales and the like, or TPR valves etc).

It is also important to note that although all plumbers are licensed to install tempering valves and thermostatic mixing valves, in some States only approved Registered Training Organisation (RTO) accredited plumbers (e.g. TAFE) can commission and maintain thermostatic mixing valves. Tempering valves are for the most part non-serviceable, and require replacement at intervals not exceeding five years as stated in *AS 4032.3*.

[1] In recognition of the high scald risk for children, older people and those living with disability, Australian Standard *AS/NZS 3500.4:2015* states that any health care buildings, including childcare and aged care facilities are required to deliver water at sanitary outlets to a maximum of 45°C.


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# Temperature Limiting Devices

There are currently a number of temperature limiting devices that are available to maintain safe water temperature delivery in the home. These include Thermostatic Mixing Valves, Tempering Valves and Water heaters (compliant with *AS 3498*)and Thermostatic Mixer Taps.

## Thermostatic Mixing Valve (TMV)

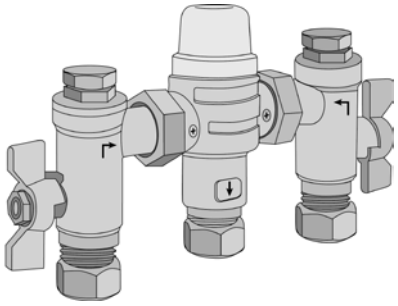

**Figure 2. Example of a Thermostatic Mixing Valve (TMV)**

A TMV is a mixing valve that is temperature actuated used to blend heated and cold water to provide mixed warm water at a temperature suitable for direct skin contact at one or more outlet fixtures.

TMVs should be installed as close as possible to the sanitary outlet (shower or bathroom taps) in order to minimse the length of any warm water dead legs, thus reducing the risk of Legionella. Whilst there is no maximum length of run stated in the PCA, various State Health Authorities do nominate varying maximum lengths of run to minimse risks. Any installation should also comply with *AS 3666*.

TMV's are the most accurate temperature regulation device of the list covered in this report with temperature tolerances within +/- 2 °C and quicker response time to fluctuations due to pressure and temperature conditions. Once installed, TMV;s currently require annual field testing inclusive of replacement of the o-rings (subject to the manufacturers instructions) and thermostat at a maximum interval of five years (subject to the manufacturers instructions).

## Tempering Valve

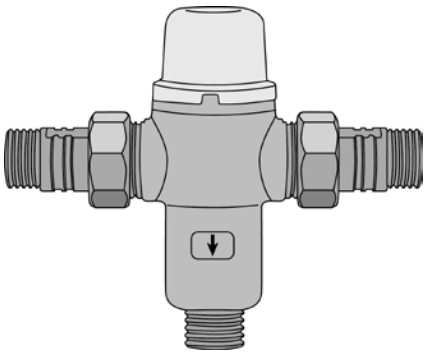

**Figure 3. Example of a Tempering Valve**

A tempering valve is a mixing valve that is temperature actuated. It is used to blend a heated water supply with cold water to provide heated water at a lower temperature at one or more outlet fixtures. Tempering valves are not designed nor intended to deliver blended warm water for direct ablution or sanitation purposes. They have a lower level technical specification than TMV's and are primarily designed to lower the temperature of hot water delivered to a tap mixing set where further cold water can be added in domestic applications.

Tempering valves can be installed to control the temperature of delivered water for an entire household, or sections of the house. Most tempering valves operate within temperature tolerances within +/- 3 °C. Once installed, they require yearly field testing and replacement at intervals not exceeding 5 years (*AS 4032.3*). The complexity of risk in a residential home sees the home owner responsible for ensuring this ongoing compliance.


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## Thermostatic Mixer (Thermostatic 'Point of Use' Mixer)

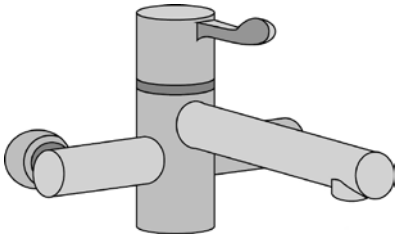

**Figure 4. Example of a Thermostatic Mixer**

A Thermostatic 'Point of Use' Mixer incorporates thermostatic control to blend heated and cold water for direct skin contact. Their performance is as per a thermostatic mixing valve. Designs vary with some brands incorporating built in isolating valves, non-return valves and strainers, whilst others require these to be installed external of the mixer. These products are currently certified to *AS 4032.1* and as such require service and maintenance in accordance with *AS 4032.3*

Note: *AS 4032.4* is not recognised under the Watermark Certification Scheme (ABCB) and therefore it cannot be used by manufacturers to certify their products at this time. Currently to approve a TMV mixer they must comply with *AS 4032.1* as a TMV and the relevant provisions of *AS 3718* as a tap.

## Water Heater (*AS 3498* compliant)

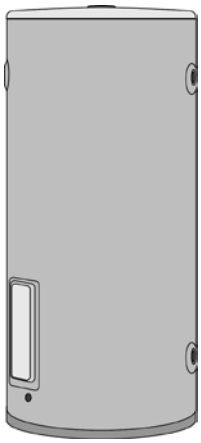

**Figure 4. Example of a water heater compliant with *AS 3498:2009***

Where a water heater has been manufactured and installed in accordance with *AS 3498: 2009*, there is no statutory requirement to fit a temperature limiting device if this water heater is installed in built enviornments other than an early childhood centre, school, aged care facility or a facility for people living with disability.

# Risk of Malfunction

In addition to the selection of an appropriate and compliant design solution, the ongoing risk management of any temperature regulation device is critical to ongoing safe usage. Malfunctions of Thermostatic Mixing Valves (TMV) in health care facilities have resulted in serious scalding injury and death (NSW Government Health, 2015). These malfunctions have been attributed to a range of systematic failures, e.g. inadequate system design, installation, commissioning, operation, maintenance and service, and site management. For installation and maintenance in a bathroom setting, there are a number of documents which detail the correct system design, installation, commissioning, operation, maintenance, service and site management procedures. These documents include; the current product supplier's instructions, relevant Australian Standards, and State Plumbing Authority technical guidelines.


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## Overview of Installation and Maintenance Requirements

Of the possible solutions that comply with relevant standards and codes, each has its own installation and maintenance requirements. Table 2 below outlines the maintenance and installation requirements of each temperature regulation design solution.

**Table 2. Maintenance and installation requirements for temperature regulation devices as per *AS 4032.3*.**

| Maintenance and installation requirements | |
|---|---|
| Thermostatic Mixing Valve | - Installation by an RTO accredited plumber only<br>- Maintenance by an accredited plumber every 12 months<br>- Replacement of 'o' ring and thermostat and any other critical components as per manufacturer's recommendations within a period not exceeding 5 years. |
| Tempering Valve | - Installation by an accredited plumber only<br>- Maintenance by an accredited plumber every 12 months<br>- Replacement as per manufacturer's recommendations within a period not exceeding 5 years. |
| Thermostatic 'Point of Use' Mixer | - Installation by an accredited plumber only<br>- Maintenance by an accredited plumber every 12 months<br>- Replacement as per manufacturer's recommendations within a period not exceeding 5 years<br>- Not currently recognized by the Watermark Certification Scheme - the mandatory certification scheme for plumbing and drainage materials administered by the ABCB. |
| Water Heater compliant with *AS 3498-2009* | - Inspection, service and maintenance requirements are set by the manufacturer |

**Source:** Adapted from *AS 4032.3:2005*.


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# Relevant Australian Codes and Standards

There are a number of National and State-based regulations relating to temperature limiting devices in household plumbing systems. These are illustrated in the Figure following.

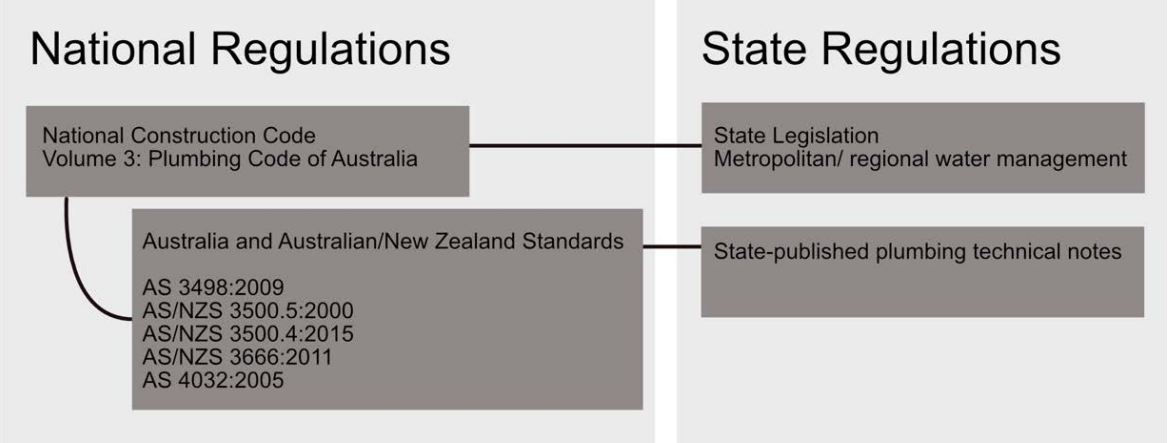


**Figure 5: National and State regulatory environment.**

Table 3 below outlines the relevant Australian Standards relating to the storage and delivery of heated water in households.

**Table 3: Australian Standards**

| Australian Codes and Standards | |
|---|---|
| **National Construction Code 2016:** Volume 3 Plumbing Code of Australia. | The National Construction Code (NCC) applies to both the construction of new buildings and new building work in existing buildings. Volume 3 covers the range of plumbing requirements with Part B2 relating to Heated Water Services. The NCC provides an overview of requirements with reference to more specific performance criteria being documented in the relevant Australian /New Zealand Standards.<br><br>It states that the design, construction, installation, replacement, repair, alteration and maintenance of a heated water service must be in accordance with—<br><br>*AS/NZS 3500.4: 2015*; or<br><br>for a Class 1a or Class 10 building only, Section 3 of *AS/NZS 3500.5: 2000*; |


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## Australian Codes and Standards

| | |
|---|---|
| ***AS/NZS 3500.4: 2015*** Plumbing and drainage – Heated water services: | This standard is part of a suite of standards (*AS/NZS 3500.0-4:2015*). Part 4 specifically covers Heated Water Services.<br><br>Section 1.9 covers the issue of water temperature. Clause 1.9.1 states the minimum storage temperature for heated water is 60°C to inhibit Legionella bacteria growth. In terms of delivery temperature, Clause 1.9.2 states that:<br><br>"All new heated water installations shall, at the outlet of all sanitary fixtures used primarily for personal hygiene purposes deliver heated water not exceeding 45°C for early childhood centres, schools, nursing homes and similar facilities for young, aged, sick, people with a disability. For all other buildings the maximum delivery temperature is 50°C."<br><br>The standard continues to explain that temperature limits are required to minimize the risk of scalding. Clause 1.9.3 outlines acceptable solutions to control delivery temperature of water. These solutions include thermostatic mixing valve complying with *AS 4032.1:2005* , tempering valve complying with *AS 4032.2:2005*, or water heater complying with *AS 3498:2009*. The Note states that temperature limiting devices require regular routine maintenance and performance testing as per *AS 4032.3:2005*.<br><br>NB: Temperature actuated flow reduction valves (end of line devices) are not approved. Thermostatic Mixing taps approved to *AS 4032.1:2005* are approved under this standard. |
| ***AS/NZS 3500.5:2000*** Plumbing and drainage – Domestic installations | Clause 3.4.1 states water minimum storage temperature for heated water is 60°C to inhibit Legionella bacteria growth. Requirements for delivery temperature (clause 3.4.2) at sanitary fixtures include "All new heated water installations shall, at the outlet of all sanitary fixtures, used primarily for personal hygiene purposes, deliver heated water not exceeding 50°C ". Compliance with this clause is not required for kitchen sinks and laundry tubs where the preferred delivery temperature is 60°C. |
| ***AS 4032.1:2005 Part 1:*** Thermostatic Mixing Valves – materials design and performance requirements | This standard covers design specifications for TMV devices, including limitation of temperature adjustment, hot water isolation requirements and sensitivity to temperature adjustments. Maintenance instructions state that the maximum time interval between maintenance for TMV is 12 months. |


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| Australian Codes and Standards | |
|---|---|
| ***AS 4032.2:2005 Part 2:*** Tempering Valves and end of line temperature-activated devices | The objective of this Standard is to provide manufacturers with requirements for tempering valves and end-of-line temperature-actuated devices that give reasonable protection to users against exposure to fluctuations in mixed water temperatures.<br><br>A note in Section 1.1 states that "tempering valves are not suitable for use in at-risk situations (health care, aged care, child care) however are suitable for general use for ablution purposes". |
| ***AS 4032.3:2005 Part 3:*** Requirements for field testing, maintenance or replacement of thermostatic mixing valves, tempering valves and end-of-line temperature limiting devices | This standard outlines the frequency of field testing for installed devices including TMV, tempering valves and end-of-line temperature –actuated devices. Field testing is required every 12 months for TMV and tempering valves. Every 1 month for end-of-line temperature-actuated devices. |
| ***AS/NZS 4032.4:2014 Part 4*:** Thermostatically Controlled taps for the control of heated waters supply temperatures | Covers performance requirements for thermostatic mixing taps, which provide a level of protection to users against exposure to high or excessive fluctuations in mixed water temperatures caused by variations, including shut-off, in the cold or heated water supply. *AS 4032.4:2005* is not currently recognised under the WaterMark Certification Scheme (ABCB) and therefore it cannot be used by manfuacturers to certify their valves to Australian Standard.<br><br>Note: This standard is not yet referenced in *AS/NZS 3500.3:2000*.<br><br>Products that are approved to this standard are not deemed to be in solution for temperature control as per *AS/NZS 3500.3:2000*. They must be indepentently compliant as both a TMV and as approved tapware (*AS/NZS 3718:2005*). |


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| Australian Codes and Standards | |
|---|---|
| ***AS/NZS 3666:2011*** Suite of Australian Standards. Requirements for field-testing, maintenance or replacement of thermostatic mixing valves, tempering valves and end-of-line temperature control devices | This suite of standards governing microbial control was developed for application in commercial buildings but has since been expended to apply to any building or structure classified in the National Construction Code (Section 1.5.11). |
| ***AS/NZS 3666:2011 Part 1:2011:*** Air-handling and water heating systems of building-microbial control. Design, installation and commissioning | This standard includes the design, installation and commissioning of water heating systems. |
| ***AS/NZS 3666:2011 Part 2:2011*****:** Air-handling and water heating systems of building-microbial control. Operation and maintenance | This standard provides guidance on the control of microorganisms, including Legionella bacteria, in buildings |
| ***AS/NZS 3666: 2011 Part 3: 2011:*** Air-handling and water heating systems of building-microbial control. Performance based maintenance of cooling water systems | For general domestic applications water storage temperatures must be a minimum of 60°C. The NCC 2016-PCA requires a maximum 50°C for water delivery temperature at outlet fixture primarily used for personal hygiene in new water heating systems not existing systems. |


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| Australian Codes and Standards | |
|---|---|
| ***AS 3498:2009*** Authorization requirements for plumbing products-Water heaters and hot-water storage tanks | This Standard specifies the basic requirements related to safety and public health for water heaters, and hot-water storage tanks that are intended for connection to a potable water supply. It sets out general requirements and conditions including temperature delivery requirements both in the storage of and the delivery of (at outlets) heated water. |

As a State example, of state based regulations, NSW has both State Legislation governing plumbing regulation and state-published technical notes see the following table.

**Table 4: State legislation and state regulations (NSW example)**

| Legislation | Description |
|---|---|
| Sydney Water Regulation 2011 | States that all plumbing must be compliant with NCC 2016-Volume 3<br><br>Makes provision for the permit requirements and compliance certificates for all plumbing and drainage work.. |
| **Technical Notes** | **Description** |
| Plumbing Industry Technical Notes | NSW Government Fair trading (2013) Plumbing Industry Technical Note 1/2013 New Installation requirements of temperature control devices<br>Link:<br>http://www.fairtrading.nsw.gov.au/biz_res/ftweb/pdfs/Tradespeople/New_installation_requirements_of_temperature_control_devices.pdf |

## Assessing Your System

If there is any uncertainty about the regulated status of a heated water system, the system should be assessed by a licensed plumbing contractor or contact the State Plumbing Regulator for advice.

Plans or a scale sketch of the system can be prepared and used to identify:

- the location of the water heater(s) and/or hot water storage unit(s),
- all temperature limiting devices (TMVs or tempering valves),
- the temperature of the water (hot, cold or warm) and
- plans of pipework indicating the direction of flow of the water.

Changes to a heated water system, such as the relocation of valves or the addition of new pipe work, may change the regulated status of the system. The system will require re-assessment when any such modifications are made.


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# Summary

At the required minimum stored water temperatures, serious scalding injury occurs quickly. People requiring home modifications are among the groups most vulnerable to scalding and thermal shock. It is mandatory in NSW that all new hot water systems in domestic situations store water at a minimum 60°C while delivering water to outlets used primarily for personal hygiene, showers, baths, basins, at a maximum of 50°C.

Existing hot water system best practice indicates implementation of anti-scald strategies to reduce the risk of scald and thermal shock. The most appropriate anti-scald strategy is determined by the specific requirements of the resident, the existing hot water system and available funding. Approved devices that can be fitted to existing water heating systems are available.

The lack of guidelines for the selection of anti-scald strategies may have resulted in unnecessary, inappropriate or incorrect installation of devices to limit water delivery temperature.

# Approaches for Compliant Water Temperature Regulation – Comparison

Anti-scald strategies or devices have features that may be considered advantages or disadvantages depending on the specific requirements or constraints of each application. These features should be considered in relation to code requirements, funding options, the needs of the consumer, and the environmental context. The advantages and disadvantages of these devices are provided in the table following


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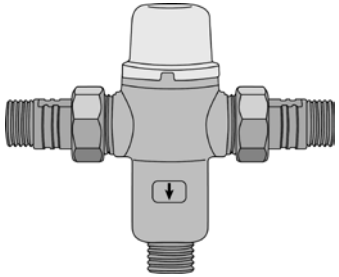
**Table 5. Advantages and disadvantages of devices for limiting water delivery temperature**

| Product Title | Installation | Advantages and disadvantages | Examples |
|---|---|---|---|
| Tempering valve (hot water mixing valve) | Licensed plumber required for installation. Accredited plumber only can commission or maintain the valve.<br>Installed at any point within pipes | ✓ This option is more feasible for new houses as the device is installed within existing pipes.<br>✓ Mixes hot and cold water prior to delivery at outlet fitting<br>✓ Allow high storage temperatures thereby reducing the risk of exposure to bacteria.<br>✓ Can be located adjacent to the hot water system regulating the temperature throughout the dwelling.<br>✓ Specific areas of the dwelling can be regulated e.g. bathroom by considered location of valve.<br>✓ Cost can be minimised by selecting the number of outlets (valves) required for regulation.<br>✓ Immediate response to temperature fluctuation at a high degree of accuracy but less immediate and less accuracy than TMV.<br>× Only selected outlets are regulated.<br>× Requires regular maintenance by accredited/licensed plumber.<br>× May not be appropriate adjacent to hot water system that services more than one dwelling such as Class 2 or 3 buildings where resident does not have control of the building's water temperature.<br>× Not suitable for high-risk environments such as aged-care, health-care or child-care environments. |  |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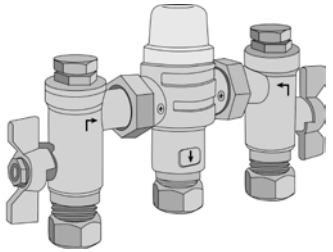
| Product Title | Installation | Advantages and disadvantages | Examples |
|---|---|---|---|
| Thermostatic Mixing Valve (TMV) | Licensed plumber required for installation. Licence plumber required for installation, but accredited plumber only can commission or maintain the valve.<br>Can be installed at point of use. i.e.: basin or shower. | ✓ This option is possibly higher cost than a tempering valve, and requires replacement within 5 years but is considered the safest and most accurate design solution.<br>✓ Mixes hot and cold water prior to delivery at point of use, minimises amount of warm water in the line available for bacterial growth.<br>✓ Allows high storage temperatures thereby reducing the risk of exposure to bacteria.<br>✓ Individual fixtures within the dwelling can be regulated e.g. Shower, Wash Basin.<br>✓ Highest temperature accuracy and most immediate response to temperature fluctuations - more highly toleranced than tempering valves.<br>✓ Suitable for high-risk environments such as aged-care, health-care or child-care environments.<br>× Requires yearly maintenance by licensed plumber and five yearly replacement of thermostatic components. |  |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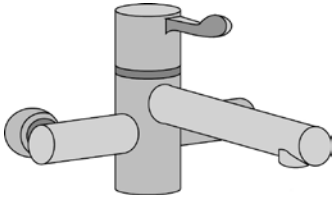
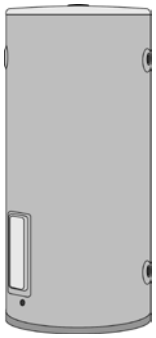
| Product Title | Installation | Advantages and disadvantages | Examples |
|---|---|---|---|
| Thermostatic Point of Use Mixer (tap) | Eliminates warm water 'dead legs' (where water is stagrnant until a flow is activated by opening a tap).<br><br>More controlled delivery of warm water. | ✓ Has the same performance as a TMV, however, the control actuator is contained within the tap fixture.<br>✓ Relates to *AS/NZS 4032.4:2014* Thermostatically Controlled taps for the control of heated waters supply temperatures .<br>× As of 2016 Thermostatic 'Point of Use' Mixers (taps) are not yet recognized within the WaterMark Certification Scheme (WMCS) for plumbing and draining products.<br>× Do not currently comply with *AS/NZS 3500* as a standalone temperature limiting device. |  |
| Heated water tank (Factory set to 50°C Compliant with *AS 3498:2009*) | | ✓ Factory set to 50°C.<br>✓ Inspection and maintenance requirements are set by the manufacturer.<br>✓ Where this tank supplies a bathroom, additional TLD are not required.<br>× Cannot be subdivided into different areas of household – the entire supply is limited to 50°C.<br>× Requires yearly maintenance by licensed plumber. |  |

*Note*: Table key for advantages and disadvantages column ✓ Advantages × Disadvantages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# Questions to Ask the Supplier

- ☐ Which devices do you sell? Why?
- ☐ How much does the device cost? Does this cost include installation?
- ☐ Do you provide written installation instructions? (There is a legal requirement for these to be included and installation instructions are a mandatory part of the product certification.)
- ☐ Do you provide written maintenance instructions? (There is a legal requirement to be included and maintenance instructions are a mandatory part of the product certification.)
- ☐ How long have you been in business?
- ☐ How many devices have you installed previously?
- ☐ Is there a warranty with the device? (There is a legal requirement of 12 months minimum. Refer to the Consumer Laws, PCA and local State requirements for plumbing workmanship).
- ☐ What does the warranty cover?


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## References

*AS 3498:2009. Authorization requirements for plumbing products - Water heaters and hot-water storage tanks* (2009). Sydney, Australia: SAI Global Limited.

*AS/NZS 3500.0:2003. Plumbing and drainage – Glossary of terms* (2003). Sydney, Australia: SAI Global Limited.

*AS/NZS 3500.1:2003. Plumbing and drainage – Water Services (2010). Sydney, Australia: SAI Global Limited.*

*AS/NZS 3500.2:2003. Plumbing and drainage – Sanitary Plumbing and Drainage (2010).* Sydney, Australia: SAI Global Limited.

*AS/NZS 3500.4:2015 Plumbing and drainage – Heated water services* (2015). Sydney, Australia: SAI Global Limited.

*AS/NZS 3500.5:2000. Plumbing and drainage – Domestic installations (2000). Sydney, Australia: SAI Global Limited.*

*AS/NZS 3666.1:2011 Air-handling and water heating systems of building microbial control-design, installation and commissioning (2011). Sydney, Australia: SAI Global Limited.*

*AS/NZS 3666.2:2011 Air-handling and water heating systems of buildingmicrobial control-operation and maintenance (2011). Sydney, Australia: SAI Global Limited.*

*AS/NZS 3666.3:2011. Air-handling and water heating systems of buildingmicrobial control-performance based maintenance of cooling water systems (2011). Sydney, Australia: SAI Global Limited.*

*AS/NZS 4032.2:2005 Water supply - Valves for the control of hot water supply temperatures - Tempering valves and end-of-line temperature-actuated devices (2009). Sydney, Australia: SAI Global Limited.*

*AS/NZS 4032.3:2005 Water supply - Valves for the control of hot water supply temperatures - Requirements for field testing, maintenance or replacment of thermostatic mixing valves, tempering valves and end of line temperature control devices (2009). Sydney, Australia: SAI Global Limited.*

*AS/NZS 4032.4:2014 Water supply - Valves for the control of heated water supply temperatures - Thermostatically controlled taps for the control of heated water supply temperatures (2009). Sydney, Australia: SAI Global Limited.*

AntiScald Inc. (2003). *Prevention of Tap Water Scald Injuries.* Retrieved 22 September 2004.

Australian Building Codes Board. (2004). *The Building Code of Australia.* Canberra, ACT: Australian Uniform Building Regulation Coordinating Council.

Blumberg, M. (2002) *Body Heat Temperature and Life on Earth* retrieved 16 November 2004 from http://www.hup.harvard.edu/catalog.php?isbn=9780674013698


ISBN: 978-0-7334-3662-8Summary Bulletin Series ISBN: 978-1-86487-753-3 **www.homemods.info**

Cassell, E., Clapperton, A., & Ashby, K. (2004). Unintentional burns and scalds in vulnerable populations: the very young and the very old. *Hazard* 57(2), 1-20. Retrieved from http://www.homemods.info/hminfo-libraries/research-library/unintentional-burns-and-scalds-in-vulnerable-populations-the-very-young-and-the-very-old-victoria-july-2001-to-june-2003#main-content

Clouatre, E., Pinto, R., Banfield, J., & Jeschke, M. (2013). Incidence of hot tap water scalds after the introduction of regulations in Ontario. *Journal of Burn Care & Research, 34*(2), 243-248.

Crouch, B (2015, February 14) Family resorts to FOI to find truth about their father's death from Legionnaire's disease *Sunday Mail South Australia.* Retrieved from http://www.adelaidenow.com.au/news/south-australia/family-resorts-to-foi-to-find-truth-about-their-fathers-death-from-legionnaires-disease/news-story/047ae496dff2bd4dcb1f278b7178f621

Dowdell, A (2014, October 7) Wife of man who died of Legionnaire's Disease at weekend warns about hot water service risk. *The Advertiser.* Retrieved from http://www.adelaidenow.com.au/news/south-australia/wife-of-man-who-died-of-legionnaires-disease-at-weekend-warns-about-hot-water-service-risk/news-story/7b90a16a077c5dcacb76f643f237c242

Garrison, L., Kunz, J., Cooley, L. (2016, June 10). Vital Signs: Deficiencies in Environmental Control Identified in Outbreaks of Legionnaires' Disease. *Morbidity and Mortality Weekly Report*. DOI: http://dx.doi.org/10.15585/mmwr.mm6522e1

Harvey, L., Mitchell, R., Brodaty, H., Draper, B., & Close, J. (2016). Dementia: A risk factor for burns in the elderly. Burns. 42;2, pp282-90

Katcher, M.L. (1987). Prevention of tap water scald burns: Evaluation of a multi-media injury control program. American Journal of Public Health, September, 77(9), 1197-1205.

NSW Fair Trading (2013) *Plumbing Industry Technical Note 1/2013* July 2013. Retrieved from http://www.fairtrading.nsw.gov.au/biz_res/ftweb/pdfs/Tradespeople/New_installation_requirements_of_temperature_control_devices.pdf

NSW Government Health (2015) Policy Directive: Water- Requirements for the Provision of Cold and Heated Water. Environmental Health Branch. Retrieved from http://www0.health.nsw.gov.au/policies/pd/2015/pdf/PD2015_008.pdf

Parenting and Child Health, (2004). *Scalds*. Retrieved from: http://www.cyh.com/HealthTopics/HealthTopicDetails.aspx?p=114&np=305&id=1501

Kakkilaya, S. (2003) *Is bathing contraindicated in fever?* Retrieved from http://rationalmedicine.org/bath.htm

Stone, M., Ahmed, J., & Evans, J. (2000). The continuing risk of domestic hot water scalds to the elderly. Burns. 26(4), 347-350.


ISBN: 978-0-7334-3662-8Summary Bulletin Series ISBN: 978-1-86487-753-3 **www.homemods.info**

Workplace Health and Safety Queensland. (2013). Guide to Legionella Control In Cooling Water Systems, including Cooling Towers. Brisbane: Department of Justice and Attorney General.

World Health Organization. (2011). Chapter 11: Microbial Factsheets In Guidelines for Drinking-Water Quality (pp. 221-295). Geneva: World Health Organization.


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# Appendix 1: Standards Relevant to Temperature Control Devices for storage and delivery of heated water.

**NCC 2016-PCA**

National Construction Code of Australia: Volume 3: Plumbing Code of Australia

**AS 3498:2009.**

Authorization requirements for plumbing products - Water heaters and hot- water storage tanks

**AS/NZS 3500.0:2003.**

Plumbing and drainage – Glossary of terms

**AS/NZS 3500.1:2003.**

Plumbing and drainage – Water Services

**AS/NZS 3500.2:2003.**

Plumbing and drainage – Sanitary Plumbing and Drainage

**AS/NZS 3500.4:2015**

Plumbing and drainage – Heated water services

**AS/NZS 3500.5:2000.**

Plumbing and drainage – Domestic installations

**AS/NZS 3666.1:2011**

Air-handling and water heating systems of building microbial control- design, installation and commissioning

**AS/NZS 3666.2:2011**

Air-handling and water heating systems of building microbial control- operation and maintenance

**AS/NZS 3666.3:2011.**

Air-handling and water heating systems of building microbial control- performance based maintenance of cooling water systems (

**AS/NZS 4032.2:2005**

Water supply - Valves for the control of hot water supply temperatures - Tempering valves and end-of-line temperature-actuated devices


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**AS/NZS 4032.3:2005**

Water supply - Valves for the control of hot water supply temperatures - Requirements for field testing, maintenance or replacement of thermostatic mixing valves, tempering valves and end of line temperature control devices

**AS/NZS 4032.4:2014**

Water supply - Valves for the control of heated water supply temperatures - Thermostatically controlled taps for the control of heated water supply temperatures


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