What is a Mixing Valve?
A device specifically designed to transport supply hot and cold water into a mixing chamber, blend and then deliver tempered, stable water at the desired outlet temperatures to downstream fixtures and fittings.

Where is it Used?
Typical applications include temperature control of domestic hot water distribution loops, sinks, line/lavatory control, tubs, and/or showers, and emergency drench equipment.
CDC estimates 8,000-18,000 people contract Legionnaire’s Disease each year, with death resulting in 5-30% of them.

1976, American Legion Conference in Philadelphia – over 4,000 attendees and over 40% became ill with flu-like symptoms. Unfortunately, 34 people died, including 2 of the men in this picture. It wasn’t until January 1977, that the CDC identified the bacteria and suggested that the bacteria was spread from the mist from a rooftop cooling tower.

**Why is a Mixing Valve Needed?**

- Hot Water is typically stored at 140°F in order to kill Legionella bacteria.

- This is too hot to be delivered to the end user, and therefore, it must be mixed with cold water to deliver safe, tempered water to the domestic hot water system (typically 120°F).

- Ensuring constant, safe outlet temperatures can also aid in the prevention of scalding.

- Using a mixing valve can also extend the storage capacity & size of the hot water source.
• ASPE Research Foundation & ASHRAE recommend 140°F as the temperature to combat Legionellae bacteria

Scalding Risks
- For most people, the risk of scalding is negligible below 120°F, but increases in severity as temperatures increase:

<table>
<thead>
<tr>
<th>Temperature</th>
<th>Time for 2nd deg burn</th>
<th>Time for 3rd deg burn</th>
</tr>
</thead>
<tbody>
<tr>
<td>120°F</td>
<td>8 min</td>
<td>10 min</td>
</tr>
<tr>
<td>130°F</td>
<td>17 sec</td>
<td>30 sec</td>
</tr>
<tr>
<td>140°F</td>
<td>3 sec</td>
<td>5 sec</td>
</tr>
</tbody>
</table>
Effects of Water Temperature

- 140°F: 1st degree burn, 3 sec.
- 130°F: 1st degree burn, 30 sec.
- 120°F: 1st degree burn, 8 min.
- 110°F: Very hot shower
- 98.6°F: Body temperature

Normal dish/clothes washing and shaving range
5 ASSE Standards that Apply to Mixing Valves:

- ASSE 1016
- ASSE 1017
- ASSE 1069
- ASSE 1070
- ASSE 1071 (and ANSI Z 358.1-2009)

www.asse-plumbing.org

“Mixing Valves 101”

Types of Mixing Valves

**Thermostatic**

Thermostatic mixing valves react very well to changes in temperature, but they can also handle pressure variations (around 10%). They will maintain stable outlet temperatures given large inlet temperature variations. Typically, Thermostatic Valves will only change 1 degree outlet temperature for every 8 degree inlet temperature change… **8° Rule.**

Technologies => There are 3 types of thermostats and each has their benefits and downfalls:

1) Bi-metal
2) Wax (aka Paraffin)
3) Bellows
Types of Mixing Valves

Pressure-Balanced

- These devices can protect against injuries resulting from thermal shock (excessive hot or cold). The danger of thermal shock is that the individual’s sudden movement away from the water coming from the shower could cause a fall and serious injury. This concern is even greater with the elderly.

- The US Consumer Products Safety Committee says that there are about 3,800 injuries and 34 deaths per year that are the direct result of excessive hot water; with elderly and people with mental and physical disabilities being the most susceptible.

Digital/ Electronic Mixing Valves

- Electronic Controls
  - Faster reactions, instant feedback eliminates control failures
- Electronic Motor
  - Stronger than all thermostatic motors!
- Communication with the Building Management System
  - Allows Monitoring for Legionella
- Self Balancing
  - No more Balancing Issues at start up and down the line.
- More Accurate Control
  - +,- 2 Degrees Temperature Tolerance, per ASSE 1017 testing guidelines
- Accountability
  - Data logging
Chapter 4 => Fixtures, Faucets and Fixture Fittings

Section 416.5 => Tempered water for public hand-washing facilities

“Tempered water shall be delivered from lavatories and group wash fixtures located in public toilet facilities provided for customers, patrons and visitors. Tempered water shall be delivered through an approved water-temperature limiting device that conforms to ASSE 1070 or CSA B125.3.” …… (Similar language in UPC Section 421.2)

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Chapter 4 => Fixtures, Faucets and Fixture Fittings

Section 424.3 => Individual shower valves

“Individual shower and tub-shower combination valves shall be balanced-pressure, thermostatic or combination balanced-pressure/thermostatic valves that conform to the requirements of ASSE 1016 or ASME A112.18.1/CSAB125.1 and shall be installed at the point of use. Shower and tub-shower combination valves required in this section shall be equipped with a means to limit the maximum setting of the valve to 120°F (49°C), which shall be field adjusted in accordance with the manufacturer’s instructions. In-line thermostatic valves shall not be utilized for compliance with this section.” …… (Similar language in UPC Section 408.3)
Chapter 4 => Fixtures, Faucets and Fixture Fittings
Section 424.4=> Multiple (gang) showers

“Multiple (gang) showers supplied with a single-tempered water supply pipe shall have the water supply for such showers controlled by an approved automatic temperature control mixing valve that conforms to ASSE 1069 or CSA B125.3, or each shower head to be individually controlled by a balanced-pressure, thermostatic or combination balanced-pressure/thermostatic valves that conform to the requirements of ASSE 1016 or CSA B125.1 and is installed at the point of use. Such valves required in this section shall be equipped with a means to limit the maximum setting of the valve to 120°F (49°C), which shall be field adjusted in accordance with the manufacturer’s instructions.” …… (Similar language in UPC Section 408.3)

Chapter 4 => Fixtures, Faucets and Fixture Fittings
Section 424.5=> Bathtub and whirlpool bathtub valves

“The hot water supplied to bathtubs and whirlpool bathtubs shall be limited to a maximum temperature of 120°F (49°C) by a water-temperature limiting device that conforms to ASSE 1070 or CSA B125.3, except where such protection is otherwise provided by a combination tub/shower valve in accordance with Section 424.3.” …… (Similar language in UPC Section 409.4)
Chapter 6 => Water Supply and Distribution
Section 607.1.1 => Temperature limiting means

“A thermostat control for a water heater shall not serve as the temperature limiting means for the purposes of complying with the requirements of this code for maximum allowable hot or tempered water delivery temperature at fixtures.”

Chapter 6 => Water Supply and Distribution
Section 613.1 => Temperature-actuated mixing valve

“Temperature-actuated mixing valves, which are installed to reduce water temperature to defined limits, shall comply with ASSE 1017.” …… (There is no language in UPC about 1017)
Thermostatic Elements

Thermostatic mixing valves use a sensing element (Bi-metal coil, liquid filled bellows, wax filled bellows, etc.) to sense incoming hot and cold supply water and blend it to the desired outlet temperature.

Many types of valves:

- Liquid Filled Bellows
  - Short life span
  
- Wax
  - Limited life, Temperature Limitations

- Bi-Metal
  - Fastest, longest lasting

Thermostatic Elements

Leonard Thermostatic Design:
DURA-trol® bi-metal thermostat

Internal parts of stainless steel or low lead materials

Locked temperature adjustment setting

Adjustable high Temperature limit stop

Union angle checkstoppers (with strainers) for top or bottom supplies
Features of the DURA-trol® bi-metal thermostat:

- Most durable element available
- Fastest reaction time due to bi-metal’s direct contact with the water stream
- No supply temperature limitations (up to live steam)
- No outlet temperature range limits
- Simple design - only 1 moving part (bi-metal directly linked to valve porting)
- Easily cleaned, spares not required at time of purchase

These other thermostats employ temperature-sensing elements that contain either a wax or an incompressible liquid. As the temperature increases, the cup (or housing) heats and then transmits the heat to the thermostatic element, therefore causing its volume to expand. This displacement is transmitted hydraulically through a piston or push rod. Note that both elements require a spring to return the thermostat to its origin.
When there is an inlet temperature or pressure fluctuation that causes a rise in outlet temperature, the highly responsive paraffin elements expand and move a piston. This allows for a restriction in the hot supply and a proportional increase in cold supply, thus maintaining the desired output temperature.

Valve operation for the various types of thermostatic elements

Next Generation Bi-Metal High/Low Valve

XL Single Valve High/Low Valve

Nucleus Digital Mixing Valve
## Installation

"FOLLOW MANUFACTURER’S SUGGESTED PIPING DIAGRAMS"

<table>
<thead>
<tr>
<th>Method</th>
<th>Circulation Flow</th>
</tr>
</thead>
<tbody>
<tr>
<td>Method # 2</td>
<td>Circulated flow is less than 8 GPM</td>
</tr>
<tr>
<td>Method # 4</td>
<td>Circulated flow is greater than 8 GPM</td>
</tr>
<tr>
<td>Method “W”</td>
<td>Wax Models only</td>
</tr>
</tbody>
</table>

**Large Valve = High Flow**

**Small Valve = Low Flow**

**By-Pass Piping = No Flow**
Piping Method # 2
Two Valve High Low System
Circulated Flow is Eight (8) GPM or Less

Method "W"
Wax Models only
Troubleshooting

• How to identify and correct problems:
  "Is the mixing valve the issue or not?"

• Step 1 – What Is the Complaint/Issue?
  – Get as much information from the user as possible
    • Listen to the symptoms......

• Step 2 – Questions to ask?
  • Is this a new installation? What type of mixing valve is installed?
  • Is this a renovation? Was a mixing valve installed before, and did it work?
  • Has the valve ever work correctly?
  • At what times does the problem occur? At what times is the water temperature ok?
  • Has other work been done to any part of the hot water system recently?

Focus in on Where to Start:

At times of demand  => Focus on the mixing valves, supply piping, heat source, fixtures
At times of no demand  => Focus on return piping, balancing valves, circulators

Common Problems:
* Return line plumbed to cold water supply and not to the bottom port of mixing valve
* No hot water to mixing valve
* Demand is lower than minimum flow of mixing valve
* Valve is too small
* Check valves in wrong direction