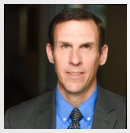
Smarter Safer Hot Water

Presented by: David Desjardins

1

Today's Presenter



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2

Outline

At the end of this presentation, you will be able to understand:

- The importance of mixing valves in a plumbing system
- The evolution of technology that blends water in mixing valves
- Thermostatic Mixing Valve technologies
- Digital Mixing Valve technology
- The benefit of Digital Mixing IoT Connected devices

3

Importance of Mixing Valves

4

The Importance of Mixing

Scalding

Legionnaires' Disease

Conservation

A rise in the number of people ***scalded*** in public buildings from hot water, the increase in ***Legionnaires' disease***, and the demands for ***water conservation*** are challenges that designers face when specifying water mixing and circulation systems.

5

Safe Water Temperature

Maintaining safe water temperatures throughout a building is crucial to public safety.

Temperature	Amount of Time for 1st Degree Burn	Amount of Time for 2nd & 3rd Degree Burn
110°F	Normal temp.	
116°F	Pain threshold	
116°F	35 minutes	45 minutes
122°F	1 minute	5 minutes
131°F	N/A	25 seconds
140°F	2 seconds	5 seconds
149°F	1 second	2 seconds
154°F	Instantaneous	1 second

- According to the American Society of Sanitary Engineering (ASSE), burn injuries can occur at temperatures **above 120°F**.
- Most codes ***recommend*** that all of the components of a hot water delivery system are set at temperatures that prevent hot water burns.
- There can be wide fluctuations in hot water temperatures supplied to any plumbing fixture, resulting in unsafe conditions and potential liabilities.

6

Safe Water Temperature

A survey of major hotel chains was conducted to review the temperatures in their hot water system at showerheads and faucets.

Hot water temperatures can vary widely throughout most building plumbing systems, causing uneven and dangerous temperature swings and inconsistent delivery temperature to fixtures and fittings.

- 115°F+ temps for showers in 91% of the first 100 rooms tested
- 120°F temps for showers in 78% of those rooms
  - *At 122°F, it takes 1 minute to produce a first-degree burn*
  - *At 140°F, it takes approx. 5 seconds to sustain a first-degree burn*
- The thermal shock from a rapid and uncomfortable change in shower temperature can ***cause a fall or serious injury***.

7

Legionella

According to the Centers for Disease Control (CDC), an estimated 8,000 to 18,000 people are hospitalized with Legionnaires' disease each year in the U.S.

- 62% of the surveyed rooms had hot water that was set at the prime temperature for the growth of the bacteria *Legionella Pneumonia*.
- Inhalation of aerosols or mists containing the bacterium is presumed to be the primary means of acquiring legionellosis.
- Aerosolized waters from cooling towers, evaporative condensers, showers and humidifiers have been identified as sources of infection.

8

Legionella

- CDC Field Investigations: 2000-2014
- Most Frequent outbreaks settings
  - Hotels - 44%
  - Long-Term care facilities -19%
  - Hospitals -15%
- Source
  - Potable Water - 56%
  - Cooling Towers - 22%
  - Hot Tubs - 7%
  - Industrial Equipment - 4%
  - Decorative Fountain - 4%

Courtesy of CDC: [illegible]

9

Reasons for Legionella Outbreaks

1) Process failures, in which a process, such as a water management program, was missing or inadequate
2) Human errors, in which a person made incorrect or unauthorized changes to the water temperature;
3) Equipment failures, in which a piece of equipment did not operate as expected, such as a malfunctioning disinfectant delivery system; and
4) Unmanaged external changes, in which adjustments were not made to account for events outside a building water system, such as nearby construction leading to changes in potable water quality

Courtesy of CDC: www.cdc.gov

10

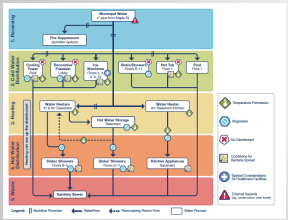
Legionella

Legionella Growth Chart

- The ideal temperature for the growth of Legionella is between 95-115 degrees F — the same temperatures that are safest to prevent scalding from hot water.
- Water temperatures must be high enough at the point of source to prevent bacterial growth and low enough to prevent scalding at point-of-use.
- When it comes to Legionella bacteria, outbreaks occur when two or more people become ill in the same place at about the same time, such as patients in hospitals.

11

Legionella



Courtesy of CDC: Toolkit

Considerations

Water Distribution Temp
- ASHRAE Guideline 12 recommends above 120 F
- Scald Prevention
  - Locate Mixing Valve as close as possible to fixture
- VA Directive 1061 – Recommends above 124 F
  - Required Monitoring:
    - Hot and Cold continuously
    - Incoming water
    - Hot Water Source – Discharge
    - Return of the circulation loop
    - Hydraulic Remote Points
  - Scald Prevention
    - POU Max 110F
  - Flushing
    - Low use fixtures 2x week

12

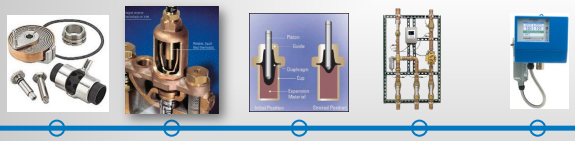
Thermostatic Mixing Valve 101

13

The Evolution of Mixing

Hot water delivery systems have been engineered using last century components and engineering.

Now, they must deliver safety at the touch of a button.



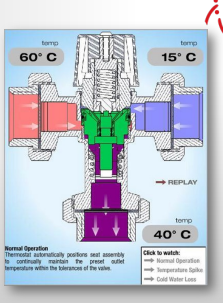
1911	1919	2000	Early 2000s	2020
Bimetal	Liquid Filled	Paraffin	Digital Mixing	Digital Mixing With IoT

14

Mixing Valves 101

Thermostatic Mixing Valve Operation

- Upon use of tempered water, a thermostat in the mixing chamber of the valve senses the outlet temperature.
- Automatically positions a seat assembly that controls the flow of hot and cold water
- If mixed outlet temperature increases, thermostat expands moving the seat assembly; allows cold-water inlet port to open more fully; restricts hot water inlet port
- If mixed outlet temperature decreases, thermostat contracts moving the seat assembly; allows hot water inlet port to open more fully, restricts cold water inlet port
- Mixed outlet water temperature is automatically and continually maintained at the preset temperature
- A mechanical adjustment permits selection of the desired outlet water temperature within range of the valve.
- Within the tolerances of the appropriate ASSE standard.



15

Mixing Valves 101

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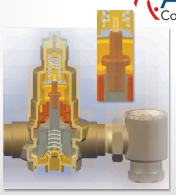
These valves provide optimal performance under the following conditions:

- Equal pressures or under 20 percent differential across inlets
- Field installation according to diagrams and proper balancing
- Properly sized valves and recirculation pumps as well as appropriately placed checks
- Implementation of a regular maintenance program
- High-quality water, free of scale and debris



Mechanical Thermostatic Mixing Valves (TMVs) continue to provide safe, reliable performance.

For the past 100 years the technology has changed little, short of adding paraffin to the actuator instead of liquid, chemical filled or bi-metal coils.

16

Mixing Valves 101

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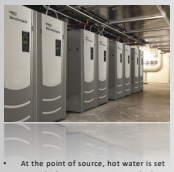
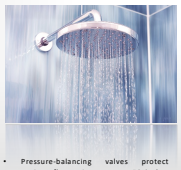


- At the point of source, hot water is set at a higher temperature and then delivered to a variety of point-of-use elements such as faucets, showerheads, laundry, and laboratory equipment.
- A well-designed system will mix hot water from the boiler with cold water to the selected temperature.

- At the point of use, the temperature of the water is controlled through thermostatic, pressure-balanced, or combination valves to the required set-point temperature.



- Pressure-balancing valves protect against fluctuations up to 50%, but limited temperature fluctuations.
- Temperature-balancing valves protect against temperature fluctuations up to 25°F, but limited pressure fluctuations.
- Temperature/Pressure balancing valves protect against pressure fluctuations up to 50% and temperature fluctuations up to 25°F.

17

Mixing Valves 101

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American Society of Sanitary Engineers

- **ASSE 1016 - Performance Requirements for Automatic Compensating Valves for Individual Showers and Tub/Shower Combinations**
  - ✓ Bath & Showers Only, Types P, T, T/P
- **ASSE 1017 - Performance Requirements for Temperature Actuated Mixing Valves for Hot Water Distribution Systems**
  - ✓ Point of Source, Type T
- **ASSE 1069 - Performance Requirements for Automatic Temperature Control Mixing Valves**
  - ✓ Gang/Single-Temp Showers, Type T
- **ASSE 1070 - Performance Requirements for Water Temperature Limiting Devices**
  - ✓ Lavatories & Whirlpools, Type T
- **ASSE 1071 - Performance Requirements for Temperature Actuated Mixing Valves for Plumbed Emergency Equipment**
  - ✓ Emergency Fixtures, Type T
- **ASSE 1062 - Performance Requirements for Temperature Actuated Flow Reduction (TAFR) Valves for Individual Fixture Fittings**
  - ✓ High Temperature Cut Off, Type T
- **ASSE 1066 - Performance Requirements for Individual Pressure Balancing In-Line Valves for Individual Fixture Fittings**
  - ✓ In-Line Pressure Balancing, Type P

18

Mixing Valves 101 – Shower Valves P and T/P

		
ASSE 1016/CSA Listing	Type P	Type T/P
Protection	Pressure	Pressure/Temp
Operating Mechanism	Diaphragm/Poppet Cartridge	Paraffin Cartridge
Seasonal Limit Stop Change	Yes	No
Integral Check Stops	Yes	Yes
Capacity/Min Flow	5.0/0.5 gpm	4.0/0.5 gpm
Facilities	Health clubs, heavy com/Institutional	Hotels, Healthcare, Assisted Living, Nursing Homes

19

Mixing Valves 101 – Point of Use Mixing Valves

			
Listings	ASSE 1070/CSA B125	ASSE 1017, 1069, 1070/cUPC	ASSE 1070/cUPC/WaterSense
Lead Free	Yes	Yes	Yes
Temperature Range	80 - 120°F	80 - 120°F	60 - 120°F
Size	3/8" comp. , ½"	½", ¾", 1" Union	3/8" comp.
Thermostat	Paraffin	Paraffin	Paraffin
Integral Checks/Filters	Yes	Yes	Yes
Capacity/Min Flow	4.0/0.5 gpm/0.25 gpm	13.0/0.5 gpm	Based on Outlet
Applications	Single lavs, banks of four lavs with 0.5 gpm outlets	Banks of lavs, whirlpools, gang showers	Single lavs, standard and gooseneck

20

Mixing Valves 101 – Point of Source Mixing Valves

				
ASSE /CSA Listing	ASSE 1017/CSA B125/UPC	ASSE 1017/CSA B125	ASSE 1017/CSA B125	ASSE 1017/CSA B125
Protection	Temperature/Paraffin	Temperature/Paraffin	Temperature/Paraffin	Temperature/Paraffin
Lead Free	Yes	Yes	Yes	Yes
Sizes	½", ¾", 1"	¾" - 2"	¾" - 2"	½ - 2" (All)
Capacity @ 45 psid	23 gpm	42 - 208 gpm	57 - 201 gpm	23 - 208 gpm
Minimum Flow Range	0.5 gpm	3 - 10 gpm	1 - 5 gpm	0.5 - 10 gpm
Temperature Range	90 -160°F standard, 60 - 120°F low	90 -160°F standard, 60 - 90°F low	90 -160°F standard, 60 - 90°F low	90 -160°F standard, 60 - 90°F low
Approach Temp.	5°F	5°F	5°F	5°F
Facilities	Hot Water Heaters	Hot Water Heaters, Boilers	Hot Water Heaters, Boilers	Hot Water Heaters, Boilers

21

Mixing Valves 101 – Point of Source Mixing Systems

				
ASSE/CSA Listing	ASSE 1017/CSA B125/UPC	ASSE 1017/CSA B125	ASSE 1017/CSA B125	ASSE 1017/CSA B125
Protection	Temperature/Paraffin	Temperature/Paraffin	Temperature/Paraffin	Digital control
Lead Free	Yes	Yes	Yes	Yes
Sizes	½" – 2"	½" – 2"	½" – 2"	½" – 2"
Pre-piped/Factory Tested	Yes	Yes	Yes	Yes
Options	Cabinets, High Temp Alarm	Cabinets, High Temp Alarm	Cabinets, High Temp Alarm, Aquastat, Pump, Balancing Valve	Cabinet, High Temp Alarm, Integrated Aquastat, Recirc Pump

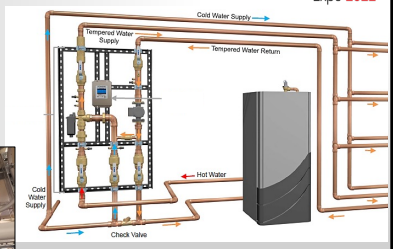
22

Digital Mixing Overview

23

Digital Mixing Benefits

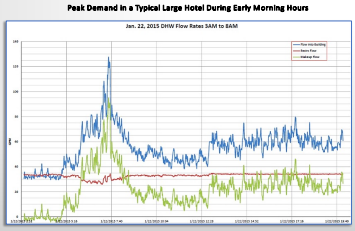
- Energy and water savings can be achieved by greater temperature stabilization of hot water delivery temperature.
- Digital mixing valves can control the entire tempered water recirculation loop at safe temperatures using electronic mixing valves, fast response sensors, and high-speed actuation.
- The components of a digital water mixing, and recirculation station can be easily replaced with union connections and isolation valves are built into the station.



24

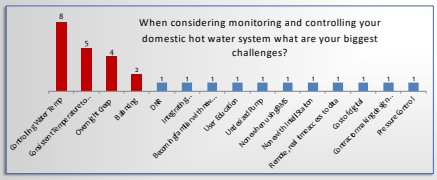
Digital Mixing Control Module Intelligence

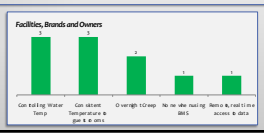
- Digital mixing stations provide more precise control of mixed water temperature, quickly adjusting to demand changes.
- This graph shows the spikes in water use in a typical large hotel during peak demand periods.



25

Why Go Digital? Facility Challenges



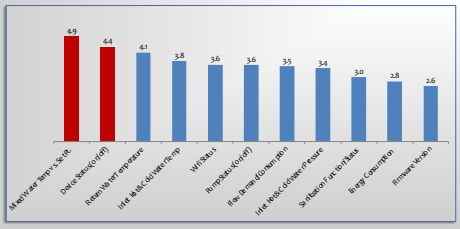


26

Why Go Digital? Facility Challenges

What's most important to monitor and adjust remotely?

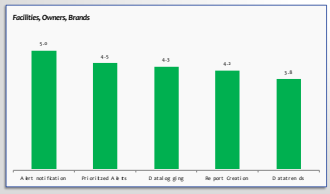
5 – most important / 1 – least important



27

Why Go Digital? Facility Challenges

Highly Valued Features



Considering a domestic water system dashboard, rate the following features in terms of desirability.
1 = Not Desirable, 5 = Very Desirable

28

Digital Mixing Features

The Smart Mixing Valve for Domestic Hot Water in Commercial and Institutional Facilities

- Certified to the same requirements of Thermostatic Valves - ASSE 1017
- Lead-free Certified to NSF requirements
- Provides temperature stabilization to the user-defined building circulation temperature within ± 2ºF as compared to ± 7ºF (valves >40gpm capacity) control required by ASSE 1017
- BAS Communication protocols available to collect and monitor system data
- Easy to commission Hi-Temp Sanitization capability to thermally mitigate Legionella bacteria

29

Digital Mixing Features

Variables that can be monitored include:

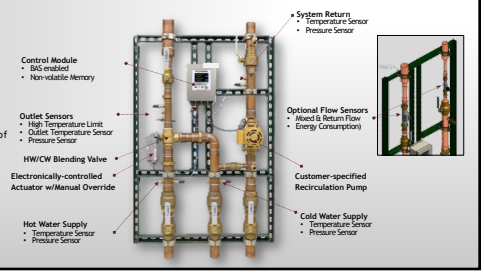
- Hot and cold supply temperature and pressure
- Mixed outlet temperature and pressure
- Return temperature and pressure
- Mixed and return outlet flow rate
- Total energy consumption

- Facility is able to access data from the system controller or through the BAS
- Digital mixing provides error codes help to troubleshoot problems
- Controller-driven smart systems anticipate conditions that may lead to system instability and takes corrective measures to preemptively return the system to stable operation

30

Digital Mixing Station Critical Components

- Available in 1 ½" and 2" sizes in single valve, dual valve and triple valve configurations
- Station capacities range from 23 gpm up to 405 gpm (@ 10 psid)
- Sensors track compliance for water management program or issues that could impact operations of the building



31

Digital Mixing Station Key Features

Dead Head Pump Control (where applicable)

- Energy is saved through the ability to detect when the system pump can no longer generate flow.
- Turns the pump off when the desired recirculation temperature is attained and turned back on if the temperature falls below a pre-set limit.

Zero Demand Temperature Protection

- An electronically controlled valve provides near 100% shutoff of hot water during zero-demand periods, eliminating the potential for temperature creep.
- Eliminates the need for a circuit setter/balancing valve, simplifying the overall set-up and maintenance of the hot water delivery system.

Power Loss Protection

- Actuator has an internal capacitor to position the valve to full cold water upon any power failure.
- Actuator has an override that allows manual adjustment of the valve during a prolonged outage. Once power is restored, the controller returns the system to the previous setting.

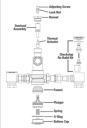
32

Digital Mixing Valve Critical Components and Features

- Available in ¾", 1", 1 ½", and 2" sizes
- Valve capacities range from 23 gpm up to 123 gpm (@ 10 psid)

33

Thermostatic vs. Digital Mixing Valve Repair Parts



Three Way Lead Free ball valve w/ check valves

Fast acting Temperature Sensor (Mixed Outlet)

Index	Description
1	Checkstop Rebuild Kit
2	Plunger Kit
3	O-Ring
4	Actuator - Standard Temperature
5	Actuator - Low Temperature
6	Funnel Kit
7	Adjusting Screw
8	Locknut

Description
Actuator Kit
High speed temperature sensor with wire kit
Controller kit

34

Digital Mixing Benefit Summary

Understanding the complex hot water system will provide tools that assist design professionals to develop more sustainable buildings.

- As architects grow in their knowledge of how to deliver buildings that are both energy efficient as well as those that conserve water, details matter.
- Digital advances in plumbing technology include new digital water mixing and recirculation systems for commercial and institutional buildings as part of a hot water regulating "plug and play" commercial boiler system.
- These units have simplified some of the uncertainties and challenges of safe hot water delivery.
  - By managing changes in temperatures and pressures, the speed of response to mixed outlet temperature changes is greatly increased.

35

IoT Connection Overview

36

Why Digital Mixing with IoT?

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More focus on remote connectivity

"If COVID-19 taught us anything as it relates to building environmental conditions, it is that **secure, remote connectivity plays a more important role than ever before** to ensure safe working conditions for occupants. The **capability to remotely monitor and maintain buildings reduces exposure risks for service employees, and provides facility managers operational visibility and control** in order to adjust equipment performance based on occupancy or environmental conditions."

—Contracting Business, June 2020

37

Why Digital Mixing with IoT?

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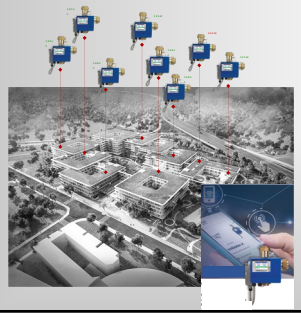


Enables Efficient Resource Deployment

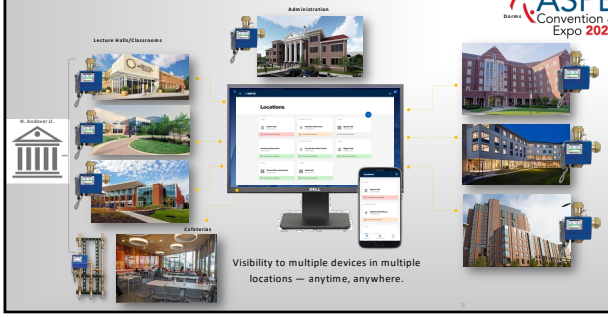
Staff and budget reductions make a tool that optimizes deployment of scarce resources highly valued

- Central monitoring via web apps provides monitoring of valve performance across multiple devices and locations from a single location point
- Adjustments can be made remotely, making local engagement with the device not required

38

Why Digital Mixing with IoT?

ASPE Convention & Expo 2022



Visibility to multiple devices in multiple locations — anytime, anywhere.

39

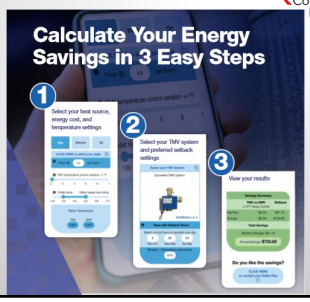
Digital Mixing IoT Features

- Remote monitoring and control on the web with mobile app
- Text, email and push alerts prioritized by safety and potential liability
- Generate PDF and CSV reports of device performance for compliance with state, local and national codes
- Temperature set back feature conserves energy during low-demand periods
- Easy documentation and reporting to meet ASHRAE 188 and CMS Mandate requirements
- Wireless connectivity

40

Online Digital Mixing Savings Calculator

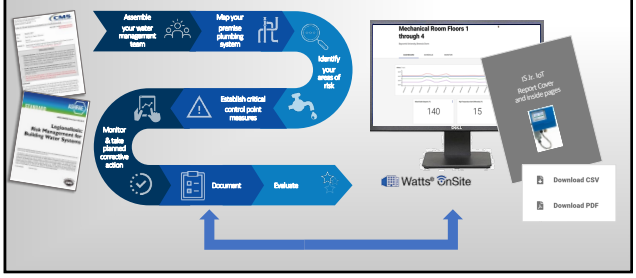
- Estimates the difference in energy cost required to heat water to desired settings.
- Calculates difference in cost between the Digital Valves and an equivalent TMV.
- Calculates energy required to raise recirculation water temperature from the lowest end of the temperature control range to the outlet and water heater temperatures.
- Energy and water savings can be achieved by greater stabilization of hot water delivery temperature, reducing the overall energy budget for hotels, hospitals, institutions, or large commercial buildings.



41

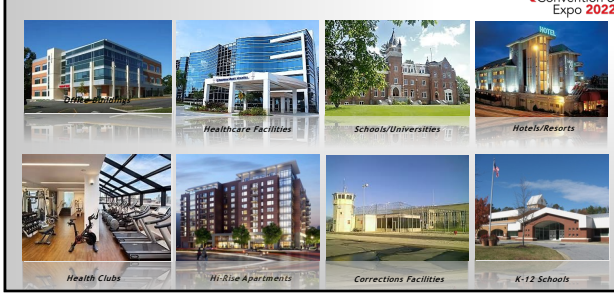
Incorporation of Digital IoT Into Quality Water Management

Reporting Compliance



42

Ideal Digital Mixing IoT Applications



43

Digital Mixing Family of Solutions

Safer and More Efficient Hot Water Delivery from Point-of-Entry to Point-of-Use

44

In Review

You should now be able to understand:

- The importance of mixing valves in a plumbing system
- The evolution of technology that blends water in mixing valves
- Thermostatic Mixing Valve technologies
- Digital Mixing Valve technology
- The benefit of Digital Mixing IoT Connected devices

45

46

Contact Us!

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47