Safe Water Delivery

Healthcare Facilities

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Learning Objectives

1. Evaluate your current water system
2. Teach and inform you of current codes and guidelines
3. Understand Legionella Risk and Prevention in Healthcare Settings
4. Teach you how to design a fool proof water system
5. Teach and inform you of current potential problems

2

Healthcare Facilities

Notorious for Complex Plumbing Systems

- Water Pre-treatment
- Water Heaters
- Recirculation & Booster Pumps
- Tempering Valves and/or Instantaneous Water Heaters
- Multiple Temperature Loops
- Loop Balancing & Multi-Zone Balancing
- Recirculation Lines
- Showers, Lavatories, Dialysis Boxes, Drinking Fountains, Ice Machines, etc.

3

Healthcare Water Delivery Concerns

The **Dangers** of Improper Water Temperatures

- **Scalding/Thermal Shock**
- Zone Recirculation Issues
- Legionella
- Sanitizing Through Fixtures
- Emergency Tempering
- Dead Legs

4

How to Mitigate Those Concerns

To help mitigate the concerns mentioned on the previous slide, **ASHRAE 188** and **Guideline 12** has been adopted by the **Joint Commission**.

- A tool to design your water management plan using ANSI/ASHRAE Standard 188.
- Requires no previous training in hazard analysis, risk assessment, or risk management.

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Deadline Has Passed!!

January 2022

The Joint Commission requires a Water Management Plan (WMP) be in place by January 1, 2022.

6

Additional Guidelines To Help You Plan

The organizations shown below also have guidelines to assist you in creating a water management plan (WMP), which include:

- How to build a water management program team.
- How to diagram your building water systems.
- How to identify areas where Legionella can grow and spread.
- Where to apply control measures and how to monitor them.
- Intervention methods if control limits are not met.
- How to ensure and effective program.
- How to document and communicate your plan.

7

What Do Almost All Guidelines Have In Common?

All guidelines state thermostatic valves help **minimize risk of scalding and Legionella** when used appropriately.

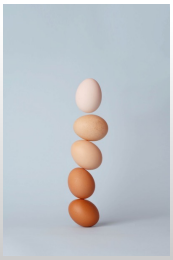
8

How to Balance the Risks?

Desired temperatures for eliminating Legionella and scalding are at odds with one another.

- Lower temperatures reduce the risk of scalding but increase the risk of Legionella growth.
- Higher temperatures reduce the risk of Legionella but increases the risk of scalding.

Thermostatic valves used throughout the facility helps balance those risks.



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Pop Quiz!

What is the ONE right way to design a healthcare plumbing system to mitigate all risks?

Q

10

Pop Quiz!

Trick Question!
There is no ONE right way to design a system.
You need to know what YOUR risks are. But…

A

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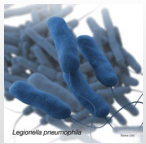
What is Legionellosis?

Legionellosis is the result of human exposure to *Legionella* bacteria. What you should know about Legionella bacteria and Legionellosis:



Legionellosis encompasses both milder and more severe illnesses that can result from exposure to Legionella bacteria, including:

- **Pontiac Fever:** A mild form of Legionellosis
- **Legionnaire's Disease:** A more severe, pneumonic form of Legionellosis.

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Sources of *Legionella* Bacteria

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Per the CDC, *Legionella* bacteria:

- Occurs naturally in fresh water and generally does not pose a health risk
- Becomes a health hazard when it grows and spreads in building water systems
- Potential sources can include:
  - storage tanks
  - water heaters
  - filters
  - aerators
  - flow restrictors
  - pipes
  - valves
  - fittings
  - water hammer arrestors
  - humidifiers
- Other, less common sources can include:
  - faucets
  - showerheads
  - misters
  - eyewash stations
  - ice machines
  - Wet component medical devices such as CPAP machines
  - hydrotherapy equipment
  - bronchoscopes
  - dialysis machines

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Legionella & Water Temperatures

Do everything possible to keep temperatures outside of the 68°F to 122°F range.

158°F	"Instant" rapid kill of bacteria
122°F	90% of the bacteria is killed in 2 hrs
95-115°F	Breeding ground for bacteria!
68°F	Dormant at temperatures <68°

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Recommended Temperatures

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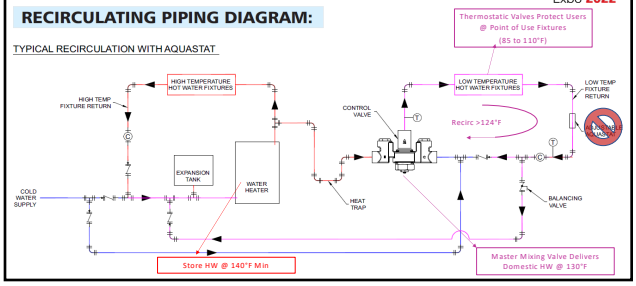
RECIRCULATING PIPING DIAGRAM:

TYPICAL RECIRCULATION WITH AQUASTAT



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JAMA Says Yes!

In a recent Journal of the American Medical Association 3-year study, it was determined that when using the methods shown (on the previous slide) the number of Legionnaires cases in VA facilities were down while the total number of cases across the US increased.

- VA medical facilities prioritized Legionnaire's disease prevention with policy.
- Older facilities without recirculation system are having problems.
- Facility prevention efforts may have contributed to improved patient safety.

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Legionella and Stagnant Water

Case Study: Seattle VA

- Built in the early 1950s
- One main building with central water distribution plant
- New additions were not tied back to the central plant
- No recirculation
- Multiple legionella outbreaks

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Covid and Stagnant Water

Stagnant water was an issue for facilities experiencing downtime due to the cancellation of elective surgeries. This problem should be solved with **a systems approach**.

- Eliminate dead legs with recirculation.
- Check dialysis boxes.
- Flush all fixtures.
- Don't forget about emergency fixtures.
- Consider climate issues with respect to water temperature.

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Pop Quiz!

What kind of tempering system is being specified more often that not in healthcare facilities?

Q

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Pop Quiz!

Digital Mixing Valves

Now, let's see why…

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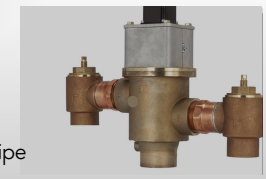
GoodDigital Master Mixing Valve

Pros
- Cost effective
- On the shelf locally

Cons
- Limited functionality
- Reliant upon contractor to pipe



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Better Digital Master Mixing Valve Station

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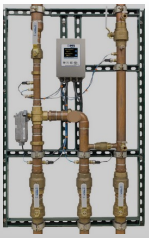
Pros
- Pre-piped Assembly
- Ability to monitor

Cons
- Fails to cold
- Reliant on building automation system (BAS)



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Best Distributed Digital Controlled System

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Pros
- Can serve as BAS
- Can be monitored remotely
- Fails to ASSE 1017 tempering

Cons
- Possible longer lead time

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Why Digital Mixing Valves?

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- Alarms when outlet temperature falls outside your water management plan (WMP) specification.
- Sanitization mode easily combats Legionella.
- Communicate with Building Automation System (BAS) if necessary.
- Eliminate temperature creep and loop balancing issues.
- Rack mounted/pre-engineered systems
  - Eliminate piping issues
  - Prevents substitutions
  - Prevents omission of checks (cross-flow)
  - Prevents omission of strainers (debris affects system)
  - Prevents omission of gauges (for trouble shooting during power outage or sensor failure)
  - Saves labor

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A Typical Healthcare Potable Water Design

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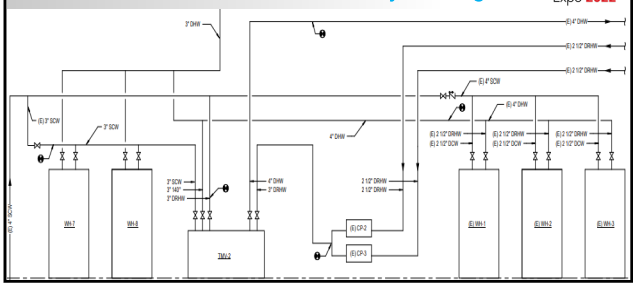
The Problem

Potable water system design



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Situation Resolved

- Forget valve only solutions.
- Integrate more than one temperature loop into a digital mixing system.

  Example 1: Low & High Temperature
  Example 2: Low Temperature & Tepid Water

- Look for pre-engineered rack mounted systems **(saving on installation and setup)**

Potable water digital system design

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Situation Resolved

Look for low temperature hot water (LTHW) and tepid water with one system/controller

- Allows for recirculation through both the tempering & emergency valves.
- Sanitizes emergency fixtures even though they fall into the tepid zone.

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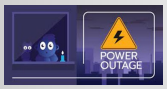
Current Situation



What happens to digital mixers, outlet temperature sensors, actuator and valves when the power goes out?

- Some manufacturers simply fail cold during a power failure risking thermal shock
- Some manufacturers provide battery backup---if you remember to keep the batteries charged.

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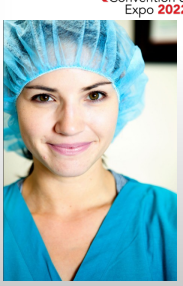
Situation Resolved

Distributed Digital Control Mixing Valves Maintain ASSE 1017 compliance when:

- The facility loses power.
- There is an actuator failure/signal loss.
- An outlet temperature sensor failure/signal loss.
- The software reboots.



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Did you know?

Surgeons spend at least **5 minutes** scrubbing their hands prior to surgery. The process has **10 or more steps**.

Should the water go cold or tepid, due to any reason mentioned previously, during the scrub, they must start the process over.

Never a good situation, but especially not during emergency surgery!

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The Problem

Zone Balancing Issues

Hospital tempering loops are often split into many zones making balancing difficult. Improperly balanced zones:

- Require Routine Adjusting
- Use Larger Pumps
- Wastes Energy
- Not Factory Set (requires an $$$ expert)

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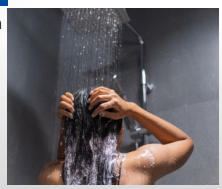
Situation Resolved

Thermostatic Zone Valve controls flow based on temperature.

- Self-adjusting
- Balance recirculated flow/heat loss based on temperature
- Deliver hot water to all fixtures all the time.
- Reduces Pump size
- Saves Energy
- Factory Set
- Some are field adjustable and allow sanitization



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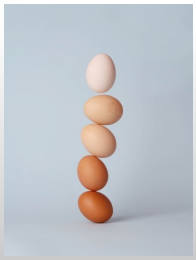
Added Protection

Pair your Thermostatic Zone Valve with a Digital Mixer that can track each zone temperature to help identify when and where you may have zone balancing issues before they become a problem.



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Domestic Hot Water Code

IECC 2009

"Automatic-Circulating Hot Water System Pumps....shall be conveniently turned off manually when hot water system is not in use"

CDC

"Store hot water at temperatures above 140°F (60°C) and ensure hot water in circulation does not fall below 120°F (49°C). Recirculate hot water continuously, if possible."

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Current Situation

Legionella Detected at Facility

- Facility has a water management plan with a course of action to eliminate the bacteria and minimize the risk of outbreak.
- Plan recommends thermal remediation/sanitization - uses elevated loop temperatures to rapidly kill the bacteria then is flushed.
- Laborious process - each fixture must be sanitized and flushed while minimizing the potential scald risk to users.

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Remediation
Hyperchlorination System

- What it is: Increasing chlorine concentrations in water to between 10 and 15 mg/L
- Pros: Relatively easy to apply, will kill off Legionella and many other microorganisms quickly.
- Cons:
  - Unreliable
  - Most expensive
  - Inadequate penetration of the agent into biofilms
  - Corrosion of the water distribution system leading to pinhole leaks over time,
  - Introduction of carcinogens into the drinking water
  - Effects last for only a few weeks.

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Remediation
Copper Silver Ionization

- What it is:
  - Uses positively charged ions and silver ions.
  - Ions bond electrostatically with negative sites on bacterial cell walls (biofilm).
  - Presence of EPA-approved levels of copper and silver ions in water systems (hot and cold) help destroy biofilms
- Pros: Controls Legionnaires' disease as well as other pathogens in cold, hot and hot water return piping systems. Federal EPA-approved.
- Cons:
  - The upfront cost and maintenance involved to repair or replace parts can be high.
  - Regional or local EPAs may or may not approve it.
  - Not effective in cases where buildings have not been used for a long period of time.

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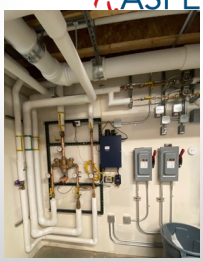
Remediation - Thermal

What it is: Thermal remediation is focused on hot water systems, and will raise the hot water temperature in the system to 160 F. It will be flushed out of distal sites for a minimum of 30 minutes.

- Pros: Kills Legionella in minutes.
- Cons: Scalding concerns, wasted water, only addresses hot water systems.



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Situation Resolved

With the digital mixers a sanitization mode can be used to remotely adjust/increase the loop temperature to kill and/or eradicate the bacteria.

On the next slide you can see a system that is sanitizing one loop while leaving the other unchanged.

This is a benefit to facilities that want to sanitize in sections. By using thermostatic point of use valves, you also minimize the risks to users or the facility personnel.

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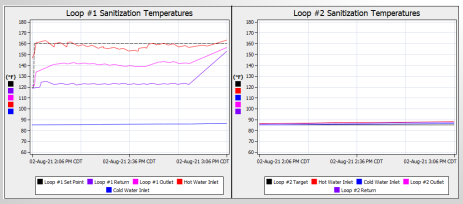
Situation Resolved



This system is sanitizing one loop while leaving the other unchanged

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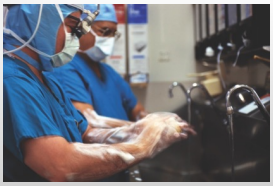
Current Situation

Thermostatic Point of Use Valves with Single Limit Stop

Safety standards require limit stops to minimize scalding and/or thermal shock.
But that single limit stop prevents flushing at fixtures.



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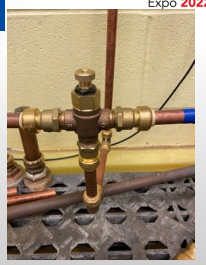
Situation Resolved

Specify valves with a second High Temp limit stop.

- Maintenance staff can override the normal limit stop setting to achieve sanitization temperature.
- Original limit stop setting is reactivated without retesting/setting.
- Eliminates time and effort associated with resetting process.
- Minimizes the potential for mistakes.



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A Safe Water Systems Approach to Dialysis

Balancing budget and patient safety.

"As design and construction budgets are becoming smaller, the significance of getting the most return value per square foot is becoming much greater. Design teams of healthcare facilities need to design spaces to improve patient flow and staff efficiency. Meanwhile, the construction teams are developing alternative methods to prefabricate systems to lower costs and reduce the overall constructions schedule of the project. Also, the design and construction team must always design with infection control as their top priority."

Think inside the box – ASPE Plumbing Engineer Magazine

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Current Situation

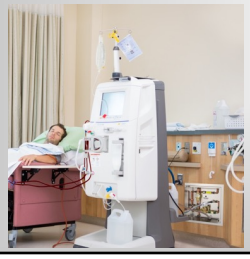
More Stagnant Water - Dialysis

Dialysis boxes are typical in a healthcare facilities and are generally used by patients/individuals that are potentially immunocompromised and have a higher risk of infection.

- Usually housed in remote locations in the hospital.
- Need dedicated cold water distribution piping.
- Dangerous cross contamination potential between patients.
- Require additional wall space and access doors.

45

Situation Resolved



Trend: Mobile Dialysis Systems

- Dialysis boxes in patient rooms
- Mobile dialysis system
- Reduce the risk of exposure to bacteria

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Comparison Of Modular Vs. Traditional Dialysis Box Systems

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Engineering/Construction Concerns

A traditional dialysis system:

- **Requires cold potable water**
- **No less than 1.6GPM**
- **Box must contain hose bib, and drain connection**
- **Additional piping in the ceiling**
- **Backflow preventer and trap primer needed, which requires a larger box**

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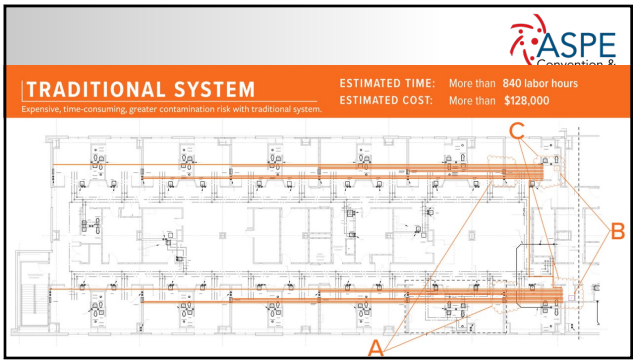
ASPE
Convention &
TRADITIONAL SYSTEM
Expensive, time-consuming, greater contamination risk with traditional system.
ESTIMATED TIME: More than 840 labor hours
ESTIMATED COST: More than $128,000
C
B
A

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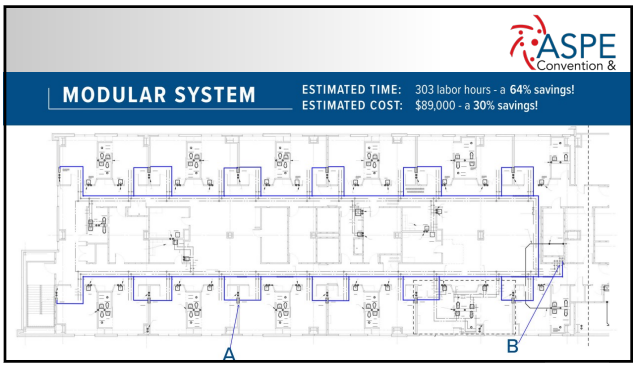
ASPE
Convention &
MODULAR SYSTEM
ESTIMATED TIME: 303 labor hours - a 64% savings!
ESTIMATED COST: $89,000 - a 30% savings!
A
B

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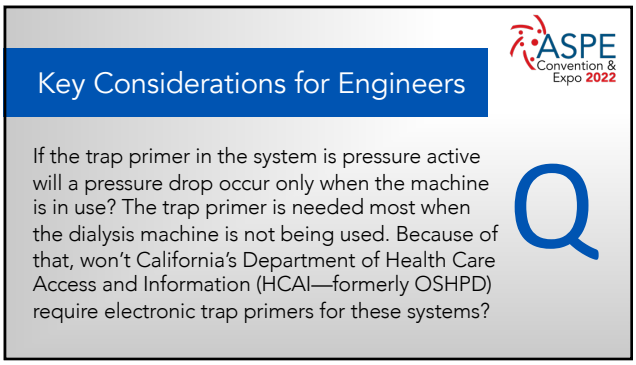
ASPE
Convention &
Expo 2022
Key Considerations for Engineers
If the trap primer in the system is pressure active will a pressure drop occur only when the machine is in use? The trap primer is needed most when the dialysis machine is not being used. Because of that, won't California's Department of Health Care Access and Information (HCAI—formerly OSHPD) require electronic trap primers for these systems?
Q

51

A common misunderstanding

"Isolation" valve is NOT the on/off for the dialysis service.
Trap primer works when box is in use or not.

A

52

Key Considerations for Engineers

The backflow in each box is a nice feature if you are doing just a couple. However, for a department like the ICU where dialysis boxes will be in every room, these backflows will be service burden as these are an Reduced Pressure Backflow Preventer (RGBP) device and therefore, will need to be serviced every year.

Q

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A common misunderstanding

Backflow preventers in every room protect patients from cross contamination.

A

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You have questions,
We have the answers!

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