MIXING VALVE TECHNOLOGIES

An Overview Brought To You By:

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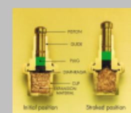
Rep Name
Rep Address
Rep Ph # - Rep Website

The Leader in Water Temperature Controls

Mixing Valve Thermostat Technologies

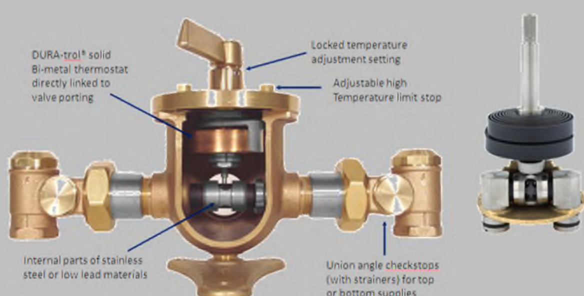
4 Types: Bi-metal, Paraffin (wax), Liquid Filled (Bellows) or Digital Electronic

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.**



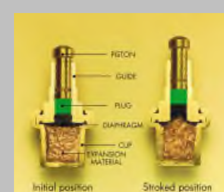
"Mixing Valves 101"

DURA-trol® bi-metal thermostat

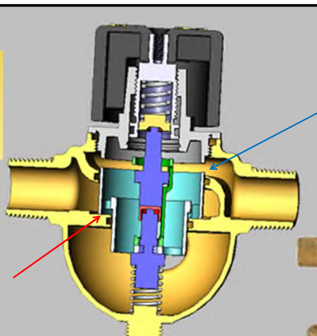


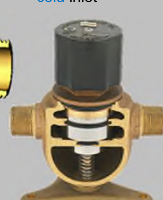
Paraffin Thermostatic Elements

Wax Filled



The other thermostat employs a temperature-sensing element that contains the wax. 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 the element requires a spring to return the thermostat to its origin.



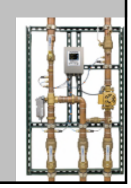


When there is an inlet temperature or pressure fluctuation that causes a rise in outlet temperature, the highly responsive paraffin elements expand and move a piston. This allows for a restriction in the hot supply and a proportional increase in cold supply, thus maintaining the desired output temperature.

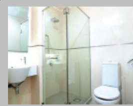
Electronic Valves

TECHNOLOGY:

- Measure temperature using electronic sensor: typically 4-20mA signal
- Process temperature in Electronic Controller
- "Closed Loop" feedback to move Mechanical Components
- Provides Precise Temperature Control



ASSE Standards



ASSE STANDARD #1016-2011 => Shower Valves

- Valves can be listed as Type T, Type P or Type T/P
- Key Performance Requirements:
  - Flow => Designed to function at a flow of 2.5 GPM
  - High Temperature Conditioning Test => Must function at 180°F (tested for 5 min)
  - Working Pressure Test => Designed to function at maximum pressure of 125 psi
  - Life Cycle Test => Tested for operation through 100,000 complete on/off cycles
  - Pressure & Temperature Variation Test:
    - **Type P** => With pressure variation of 50% to inlets, must maintain +/- 3.6°F of set output temperature.
    - **Type T** => With pressure variation of 20% to inlets, must maintain +/- 3.6°F of set output temperature within 5 seconds. With hot water temperature increase of 25°F, cannot exceed upward spike of 5.4°F within the first 1.5 seconds
    - **Type T/P** => Must meet both Type P & Type T test conditions, must meet type P.
  - Cold Water Failure => Must reduce discharge to 0.5 GPM or less within 5 seconds to ensure output temperature does not exceed 120°F

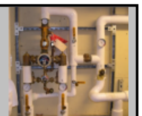
IPC/UPC & Mixing Valves

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**/ASME A112.1016/CSA B125.16 or ASME A112.18.1/CSA B125.1 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)

ASSE Standards



ASSE STANDARD #1017-2009 => Mixing Valves for Hot Water Distribution Systems

- Key Performance Requirements:
  - Conditioning Testing => Must perform when subjected to 200°F at a flowing pressure of 125 psi (any leak is considered a failure)
  - Hydrostatic Pressure Test => No leaks allowed when valve body subjected to 500 psi
- Temperature Control Test => Permissible temperature variation is based on flow at 10 psi:
  - 3.0 – 5.0 GPM => allowed **+/- 3°F**
  - Over 5.0 – 40.0 GPM => Allowed +/- 5°F
  - Over 40.0 GPM => Allowed +/- 7°F
- Hot/Cold Water Failure Test => NO REQUIREMENT EXISTS….there is no shut-off requirement for a loss of cold/hot water!!!

IPC/UPC & Mixing Valves

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)

ASSE Standards

ASSE STANDARD #1069-2005 = > Automatic Temperature Control Mixing Valves (for "Gang Showers")

- Key Performance Requirements: The most *rigorous* for a thermostatic valve!
  - High Temperature Conditioning Test => Must function at 180°F (tested for 5 min)
  - Working Pressure Test => Designed to function at maximum pressure of 125 psi
  - Life Cycle Test => Tested for operation through 100,000 complete on/off cycles
- Pressure & Temperature Variation Test => With pressure variation of 20% to inlets, must maintain +/- 3.6°F of set output temperature.
- With hot water temperature increase of 25°F, cannot exceed upward spike of 5.4°F within first 1.5 seconds.
  - *Sound familiar??....it's the same requirement as ASSE 1016 Type T*
- Cold Water Failure => Must reduce discharge to 0.5 GPM or less within 5 seconds to ensure output temperature does not exceed 120°F for devices ¾" and smaller, or 1.0 GPM for devices larger than ¾"

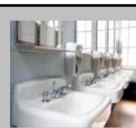
IPC/UPC & Mixing Valves

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**/ASME A112.1016/CSA B125.16 or ASME A112.18.1/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)

ASSE Standards



ASSE STANDARD #1070-2004 => **Temperature Limiting Devices**

Key Performance Requirements:

- High Temperature Conditioning Test => Must function at 180°F (tested for 5 min)
- Working Pressure Test => Designed to function at maximum pressure of 125 psi
- Life Cycle Test => Tested for operation through 100,000 complete on/off cycles
- Hydrostatic Pressure Test => No leaks allowed when valve body subjected to 500 psi

- Regulation and Temperature Variation Test => Increase and decrease supply pressures 20% and increase inlet hot + 25°F, the valve outlet shall remain **< 120°F at all times** and shall maintain w/in **+/-7°F**

- Cold Water Failure => Must reduce discharge to 0.2 GPM or 20% of manufacturer's suggested minimum flow, within 1 second to ensure output temperature does not exceed 120°F

IPC/ASSE 1070 Mixing Valves

2015 IPC Chapter 4 & 6 **Fixtures, Faucets and Fixture Fittings**

"The discharge water temperature from a bidet fitting shall be limited to a maximum water temperature of 110°F (43°C).
For a bathtub or shower 120°F (49°C) unless protected by a 1016 valve, by a water temperature limiting device conforming to **ASSE 1070** or CSA B125.3." ……

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)

IPC/ASSE 1070 Mixing Valves

Chapter 4 => **Fixtures, Faucets and Fixture Fittings**

Section 424.5=> **Bathtub and whirlpool bathtub valves**

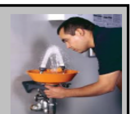
"The hot water supplied to bathtubs and whirlpool bathtubs shall be limited to a maximum temperature of 120°F (49°C) by a water-temperature limiting device that conforms to **ASSE 1070** or CSA B125.3, except where such protection is otherwise provided by a combination tub/shower valve in accordance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

ANSI Z358.1(2014)

Emergency Eyewash and Shower Equipment

- Key Points:
  - Applies to fixtures, **not** to the mixing valve
  - Deliver Tepid Water to the fixtures **60ºF < 100ºF**
  - Deliver Tepid Water for 15 minutes flushing time
  - Deliver it in the appropriate drenching amounts:
    - 3 GPM for Eyewash
    - 8 GPM for Eye/Face Wash
    - 20 GPM for Drench Shower Combination Unit

ASSE Standards



ASSE STANDARD #1071-2012 => **Emergency Mixing Valves**

- Key Performance Requirements:
  - Conditioning Test => Must function at 200°F at flowing pressure of 125 psi (tested for 6 hrs)
  - Temperature Control Test => Permissible temperature variation is based on flow at 30 psi
    - < 7.0 GPM => Allowed +3°F / -5°F
    - 7.0 < 20.0 GPM => Allowed + 5°F / -8.0°F
    - 20.0 < 40.0 GPM => Allowed +/7°F / -12°F
    - 40.0 GPM and over => Allowed +7°F / -15°F
  - Maximum Outlet Temperature Test => Verification that device cannot be inadvertently adjusted to an outlet in excess of 100°F
  - Hydrostatic Pressure Test => No leaks allowed when valve body subjected to 500 psi

- Hot Water Shut-off Test => Must achieve manufacturer's **stated by-pass flow rate** at 30 psi
- Cold Water Supply Failure => upon failure of cold, output temp can't exceed 100°F prior to these rates:

Flow @ 30 PSI Diff.	*Max Flow*
<7.0 GPM	0.5 GPM
7.0 GPM < 20.0 GPM	1.0 GPM
20.0 GPM < 40.0 GPM	1.5 GPM

IPC/UPC & Mixing Valves

Chapter 4=> **Fixtures, Faucets and Fixture Fittings**

Section 411.1 => **Emergency Showers and Eyewash Stations**

"Emergency showers and eyewash stations shall conform to ISEA Z358.1." …… (Similar language in UPC Section 416.1 and 416.2)

Note: Currently there is not a statement in the IPC or UPC addressing emergency mixing valves and **ASSE 1071**.

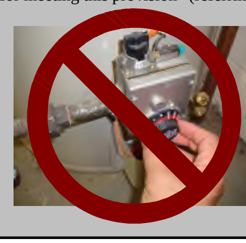
True or False – For ASSE 1017 (master mixers), there is a requirement to reduce the flow if there is a failure of cold water supply to the valve???

IPC/UPC & Mixing Valves

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." (Several sections of the UPC that state "Water heater thermostats shall not be considered a control for meeting this provision" (referring to water temp control)

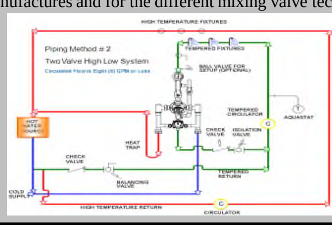


IPC/UPC & Mixing Valves

Chapter 6 => **Water Supply and Distribution**

Section 607.2.2=> **Recirculating pump**

"Where a thermostatic mixing valve is used in a system with a hot water recirculating pump, the hot water or tempered water return line shall be routed to the cold water inlet pipe of the water heater and the cold water inlet piping or the hot water return connection of the thermostatic mixing valve." …… (no language in UPC, and also be aware that there are different piping methods for the various manufactures and for the different mixing valve technologies.)



True or False - Per the IPC/UPC, even if you have an ASSE 1017 master mixer installed, you still need an ASSE 1070 device installed for lavatory applications???

"Mixing Valves 101"

Why is a Mixing Valve Needed?

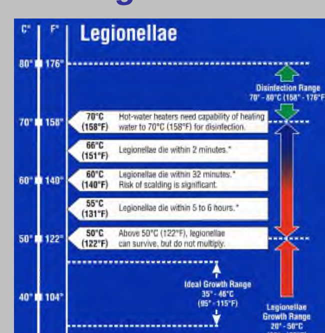
Hot Water is typically stored at 140°F in order to kill Legionella bacteria. This is too hot to be delivered to the end user, and therefore, it must be mixed with cold water to deliver safe, tempered water to the domestic hot water system (typically 120°F). Ensuring constant, safe outlet temperatures can also aid in the prevention of scalding. Using a mixing valve can also extend the storage capacity & size of the hot water source.

Scalding Risks

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

Temperature	Time for 2nd deg burn	Time for 3rd deg burn
120°F	8 min	10 min
130°F	17 sec	30 sec
140°F	3 sec	5 sec

"Mixing Valves 101"

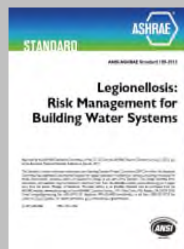


CDC estimates 8000-18000 people contract Legionnaire's Disease each year, with death resulting in 5-30% of them.

Legionella and Pertinent Codes, Standards and Guidelines

ASHRAE Standard 188-2015

- New standard aimed to Minimize Risk of Legionella (June 2015)
- Building Designer/Owner Requirements:
  - Survey building to identify devices related to Legionella (ie whirlpools)
  - If any devices are identified, a *Program Team* must be created to:
    - Identify the potable and nonpotable water systems (equipment, etc)
    - Graphically describe s process flow diagram of the systems (as built, not plans)
    - Establish a system for monitoring that the control measures are within limits
    - Establish corrective actions when monitoring shows measures are outside limits (Note: this will likely include flushing, disinfection, etc), and also contingency plans
    - Bottom line……Documentation, Documentation, Documentation
    - Opportunity…….Continuous monitoring of various water temperatures



ANSI/ASHRAE STANDARD 188-2015

- RISK MANAGEMENT FOR BUILDING WATER SYSTEMS
  - Applies to occupied commercial, institutional, multi-residential & industrial bldgs
  - Elements of water management program
    - Program Team: develop and implement program
    - Describe Water Systems: detailing the systems
    - Analysis of Building Water Systems: identify hazardous conditions
    - Control Measures: where to apply
    - Monitoring/Corrective Actions: procedures for monitoring within limits
    - Confirmation: procedures ensuring implementation and effective control
    - Documentation: establish and communicate

ESTABLISH FORMAL PROGRAM MANAGEMENT

HOT WATER SYSTEM DESIGN & LEGIONELLA

- SIMPLEST MOST COST EFFECTIVE APPROACH
- According to ASHAE 2000:
  - Turn up the Hot Water Source: existing system
  - Ideal Growth Range for Legionella: 95-115°F (35-46°C)
  - High Temperature Water: Minimum 140°F (60°C) kills bacteria 32 mins.
  - Legionella Disinfection Range: 158 – 176°F (70-80°C)
  - Recirculate: Minimum 124°F (51.1°C)
  - Minimize: Recirculation Dead legs

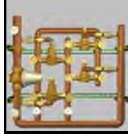
LIMMITED ADDITIONAL SYSTEM COSTS

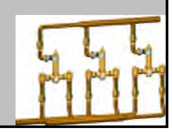
Legionella Standard Revolutionizing the Industry

Examining Issues all conventional thermostatic mixing valves have:

- Temperamental piping
- Balancing issues on recirculation
- Calcium & Lime Deposits hinder the motor
- Can't communicate with Building Systems

We can IMPROVE!!!





The Answer!!!!

- **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

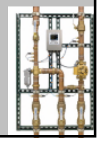
PRODUCT SOLUTIONS

- LEVERAGE TECHNOLOGY TO ACHIEVE TIGHT CONTROL, MONITORING & DISINFECTION
  - Integrate electronics into controls
  - Design and provide "closed loop" sensor feedback to electronic controls
  - Allows for tight (+/- 2°F) temperature control
  - Easy to read digital temperature display; with error codes and alarms
  - Provide monitoring solutions that easily communicate with today's Building Management Systems and display any and all sensor input data
  - Allow for safe creation of disinfection cycles either locally or remotely

CONTROL, MONITOR & DISINFECT

PRODUCT FEATURES

- MONITOR & COMMUNICATE
  - Via Building Management System
    - Standard protocol languages on-board
    - BACnet IP&MS/TP, Modbus RTU&TC/IP, Metasys N2 by JCI, EtherNet IP
    - ****BTL certified****
    - Monitor, receive & interface with BMS
    - Remote temperature adjustment
    - Modular/buildable capabilities include up to:
      - 8 temperature, 3 pressure and 2 flow channel inputs



EASILY MONITOR & COMMUNICATE CRITICAL SENSOR INPUT DATA

"Engineered Products"

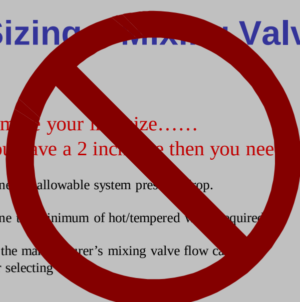
to be paired with conventional thermostatic valves

LMS-188-4P

- Measures and communicates 4 temperatures
- BACNET TCP/IP Protocol
- BACNET Certified (Pending)
- Battery Backup
- Remote alarm (nurses station) w/ adjustable relay period (delay in alarm, temp range)
- **Why important?** => Legionella and new code directives for temperature monitoring!!!

The Alternate Solution

Sizing ... Valve



STEP#1
Determ... your ...ize……
"If you ...ve a 2 inc... then you nee... 2 inch valve"

STEP#2
Determine ... allowable system pres... ...op.

STEP#3
Determine ... ...inimum of hot/tempered ... ...quire...

STEP#4
Consult the ma... ...rer's mixing valve flow ca... chart for selecting ...

Sizing a Mixing Valve

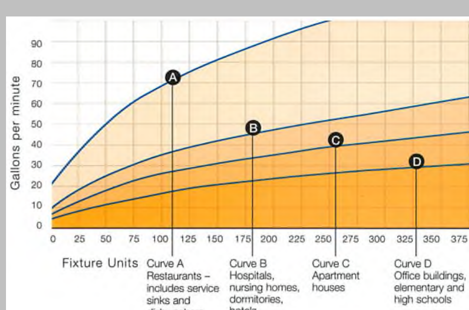
STEP#1
Determine the maximum amount of tempered water required.

STEP#2
Determine the allowable system pressure drop.

STEP#3
Determine the minimum of hot/tempered water required.

STEP#4
Consult the manufacturer's mixing valve flow capacity chart for selecting model.

Modified Hunter's Curve



The Theory: These four categories of occupancies use hot water with dramatically different diversity than the uniform Hunters model.

Fixture Units

Table 3 - Hot water demand in fixture units, 140 F

	Apartment house	Club	Gymnasium	Hospital	Hotels and dormitories	Industrial plant	Office building	School
Basins,								
private lavatory	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75
public lavatory		1.0	1.0	1.0	1.0	1.0	1.0	1.0
Bathtubs	1.5	1.5		1.5	1.5			
Dishwashers	1.5	Five fixture units per 250 seating capacity						
Therapeutic bath				5.0				
Kitchen sink	0.75	1.5		3.0	1.5	3.0		0.75
Pantry sink		2.5		2.5	2.5			2.5
Slop sink	1.5	2.5		2.5	2.5	2.5	2.5	2.5
Showers*	1.5	1.5	1.5	1.5	1.5	3.0		1.5
Wash fountain								
Circular		2.5	2.5	2.5		4.0		2.5
Semicircular		1.5	1.5	1.5		3.0		1.5

* In applications where the principal use is showers, such as in gymnasiums or at the end of a shift in industrial plants, use a conversion factor of 1.0 to obtain the design water flow rate.

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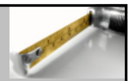


Sizing a Mixing Valve

STEP#1
Determine the maximum amount of hot/tempered water required.

STEP#2
Determine the allowable system pressure drop.
* Typically 10, 15, or 20 psi

System Pressure Drop = the pressure available at the inlet of the mixing valve minus the pressure required to operate the farthest fixture (i.e., shower valve in a building)

STEP#3
Determine the minimum of hot/tempered water required.

STEP#4
Consult the manufacturer's mixing valve flow capacity chart for selecting model.

Sizing a Mixing Valve

STEP#1
Determine the maximum amount of hot/tempered water required.

STEP#2
Determine the allowable system pressure drop.

STEP#3
Determine the minimum amount of hot/tempered water required.

STEP#4
Consult the manufacturer's mixing valve flow capacity chart for selecting model.

Sizing a Mixing Valve

STEP#3 => Determine the minimum of hot/tempered water required.

Watch out for the "Asterisk"!!!!

"Minimum flow when the valve is installed at or near the hot water source w/ recirculated tempered water with a properly sized continuously operating recirculating pump."

Be sure to review true minimum flows of the valve independent of recirculation!

Sizing a Mixing Valve

STEP#1
Determine the maximum amount of hot/tempered water required.

STEP#2
Determine the allowable system pressure drop.

STEP#3
Determine the minimum amount of hot/tempered water required.

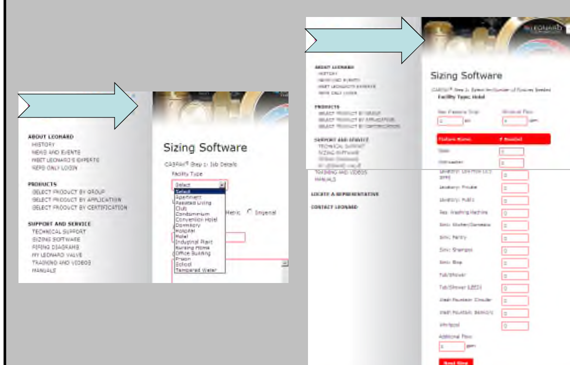
STEP#4
Consult the manufacturer's mixing valve flow capacity chart for selecting model.

Flow Capacity Chart

FLOW CAPACITIES

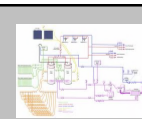
MODEL	IN	OUT	MINIMUM FLOW GPM L/MIN	SYSTEM PRESSURE DROP 5 .3	(10) .7	(15) 1.0	(20) 1.4	25 1.7	30 2.1	35 2.4	40 2.8	45 3.1	50 3.4	PSI BAR
A	3/4" 19mm	1" 25mm	1.0 3.8	13 49	19 72	25 95	30 114	34 129	37 140	41 155	45 170	47 182	49 185	GPM L/MIN
B	3/4" 19mm	1" 25mm	1.0 3.8	19 72	29 110	38 144	45 170	51 193	56 212	62 235	68 257	72 272	75 284	GPM L/MIN
C	1" 25mm	1 1/4" 32mm	1.0 3.8	26 98	40 151	48 182	58 220	63 238	68 257	74 280	79 299	84 318	89 337	GPM L/MIN
D	1 1/4" 32mm	1 1/4" 32mm	1.0 3.8	33 98	47 151	56 212	63 220	68 238	82 257	85 280	92 299	103 318	115 337	GPM L/MIN
E	1 1/4" 32mm	1 1/2" 38mm	1.0 3.8	48 182	65 273	80 333	95 360	112 424	120 454	130 492	140 530	158 598	165 625	GPM L/MIN
F	2" 51mm	2" 51mm	1.0 3.8	78 295	113 428	129 488	145 549	163 617	172 651	188 712	197 746	214 810	226 856	GPM L/MIN
Maximum Flow Capacity														

Valve Sizing

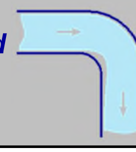


True or False – Line size is a consideration when sizing a master mixing valve???

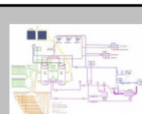
Recirculation - What is it? And Why do we need it?



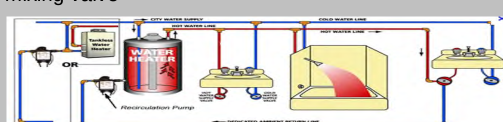
- Simply: It is a mixture of hot and cool flowing water which maintains loop temperature at times of "no demand" in a tempered system! => We're "making up" for the heat loss in the domestic hot water loop
- Remember…it is a closed loop system during periods of no demand…….
  - So, if we did not have circulation, the loop would go cold (ambient) during times of "no demand" because the water is not moving
- ***Keep the water moving and add a little hot!***



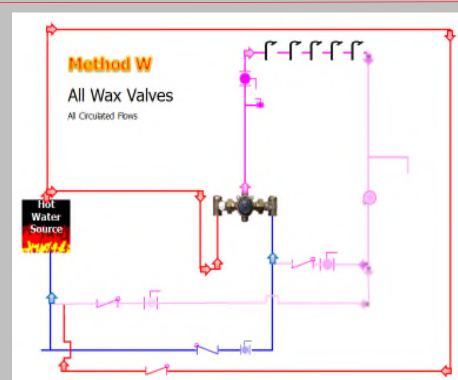
Recirculation - What is it? And Why do we need it?



- ***HEAT LOSS:*** Pump exit water is cooler than when it left the Mixing Valve due to location (end of long run of piping)
  - Typically leaves the MV at 120°F and @ 5-10°F temp loss
- The Theory => Return/tempered water gets split – one line typically goes back to the heater/heat source via a tie into the cold supply line, and one back to the mixing valve

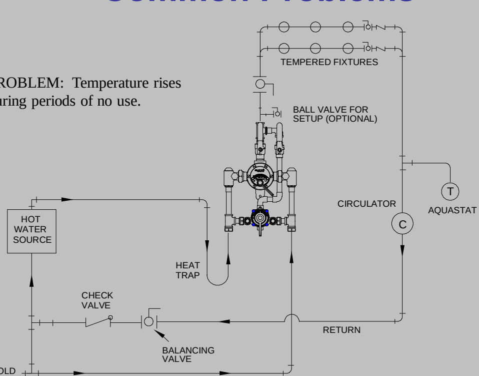


Piping Method



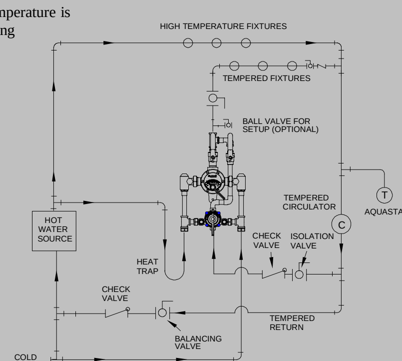
Common Problems

PROBLEM: Temperature rises during periods of no use.



Common Problems

PROBLEM: Temperature is erratic; likely rising



True or False – For recirc piping, during periods of no demand, you should send 100% of the return tempered water back to the hot water source???

Thank You!