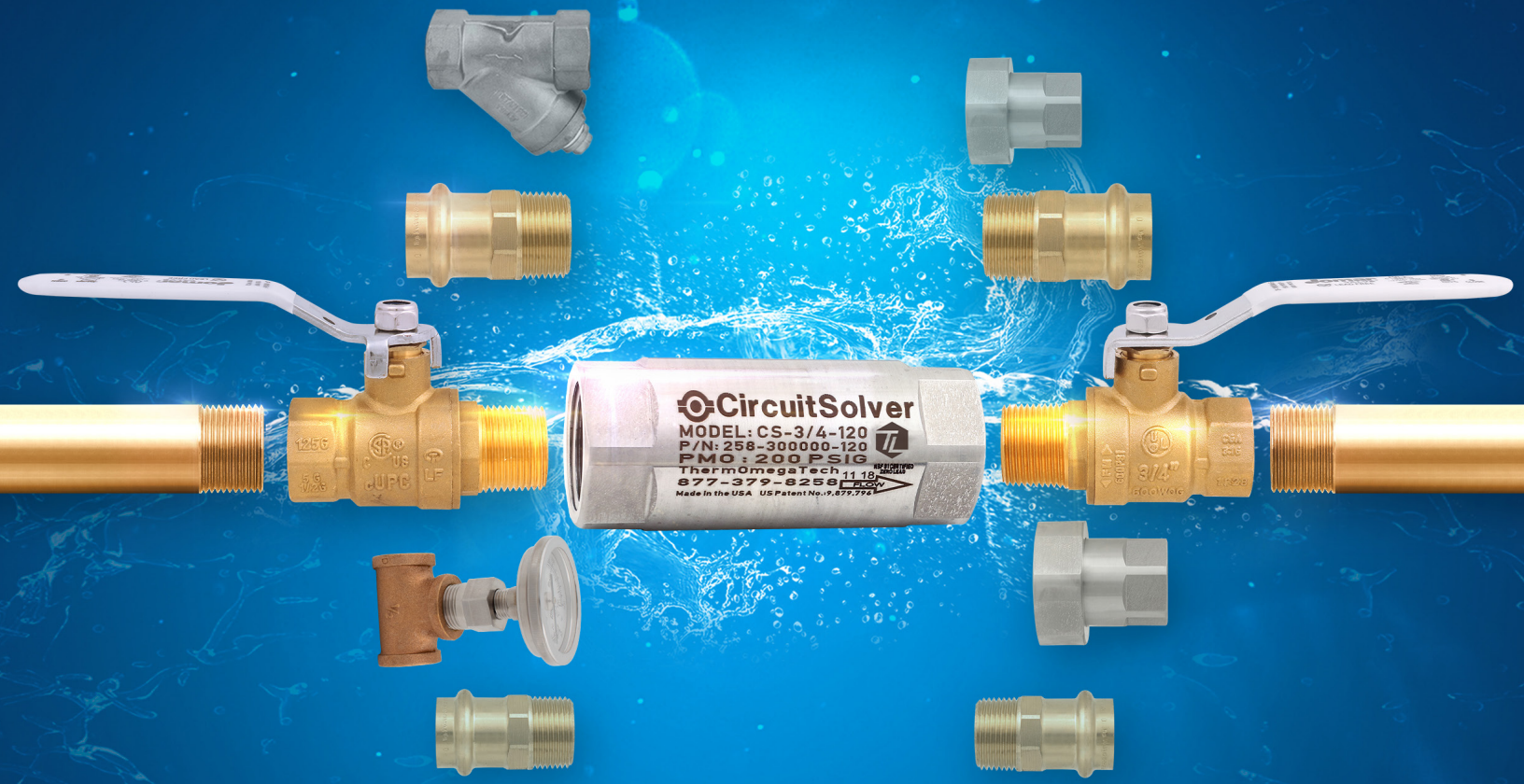
Embrace the Technology®

CircuitSolver®

A ThermOmegaTech® brand

Thermostatic Balancing Valves For Domestic Hot Water Systems



Offered in a variety of sizes up to 2" with configurations including ball valves, integrated unions, check valves, strainers, thermometers, and ProPress ends.

All CircuitSolver® Valves are NSF/ANSI 61 Certified

www.CircuitSolver.com
1-877-379-8258

ThermOmegaTech's QMS is certified to the AS9100 D Standards which includes ISO 9001:2015

Domestic Hot Water Recirculation Balancing

CircuitSolver® Basics

CircuitSolver® is a self-actuating thermostatic balancing valve that automatically and continuously adjusts flow through a domestic hot water recirculation (DHWR) system to maintain the specified temperature at the end of each branch/riser.

Balancing the system in a fraction of the time, this valve eliminates time-consuming and expensive manual balancing labor during start-up and maintenance.

The Need: DHWR systems need to be balanced in order to ensure that hot water is available throughout the building on every floor, at every fixture, at all times.

The Problem: Buildings typically require multiple branches off the hot water supply line and water flows in the path of least resistance which constantly changes in dynamic, open systems.
Manual balancing valves and fixed flow devices rely on flow and pressure calculations and cannot respond dynamically to changing needs.

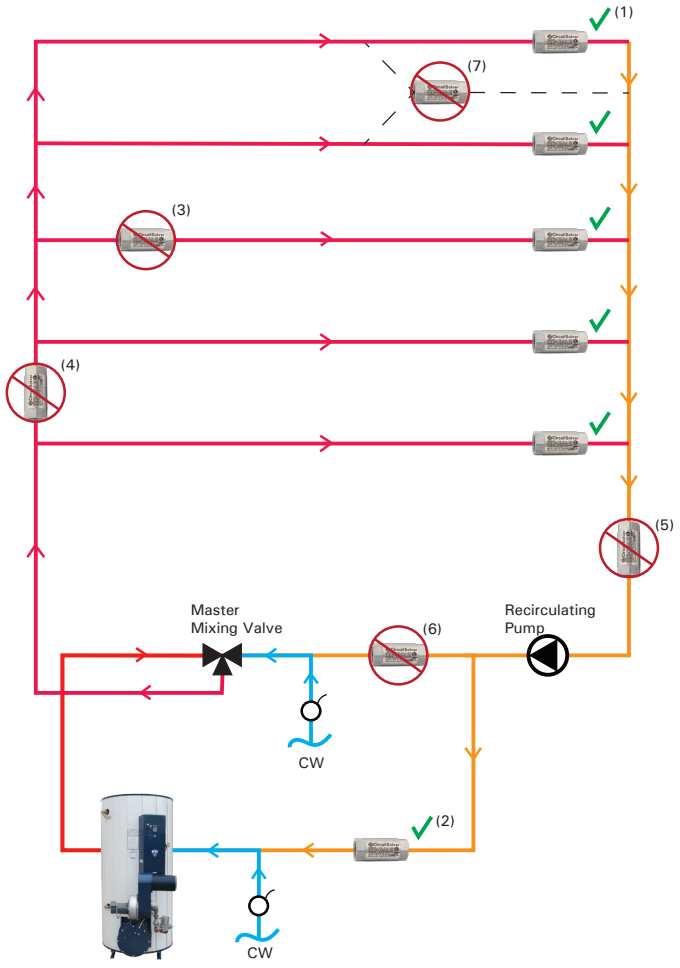
The Solution: Install a CircuitSolver® at the end of each branch, downstream of the last fixture, and the system balances itself.

How It Works: The thermal actuator at the heart of the CircuitSolver® modulates the valve between open and closed in response to changing water temperature. This continuous response to temperature variation enables each hot water branch to quickly and consistently direct hot water flow to where it is needed – No manual balancing required.

The valve never fully closes which allows a small amount of bypass flow to the return to avoid deadheading the recirculation pump.

CircuitSolver® Placement Do's and Don'ts

(1) ✓ at the end of each branch/riser
(2) ✓ in the return line back to the water heater
(3) ⊘ not in the middle of a branch/riser
(4) ⊘ not in a supply line
(5) ⊘ not in the return line
(6) ⊘ not after the recirculating pump
(7) ⊘ don't combine 2 branches/ risers



Valve Selection

Size: Select the size equivalent to the branch/riser feeding the return line.

Temperature: Select the set-point temperature equal to the desired return temperature.

Example: A standard CircuitSolver® installed on a 3/4" branch/riser with a 120˚F return temperature would be CS-3/4-120.

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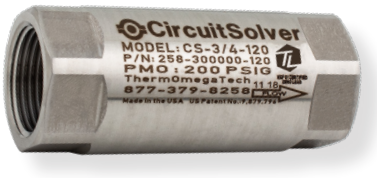
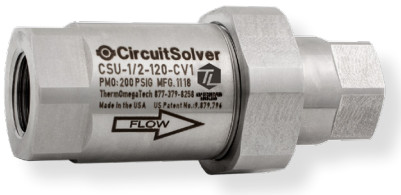
CIRCUITSOLVER®
CS, CSU, CSUA, CSUAS & Accessories

CircuitSolver® (CS)

ThermOmegaTech's standard thermostatic, self-actuating balancing valve, CircuitSolver®, adjusts the flow through a domestic hot water recirculation system to maintain a specified return temperature at the end of each branch.



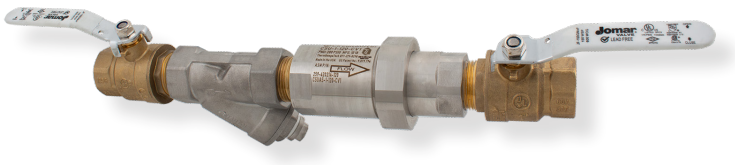


CircuitSolver® Union (CSU)

The CircuitSolver® Union is equipped with an integrated union and optional check valve to reduce the number of system components being installed. It features an integrated o-ring for a leak-free seal.

CircuitSolver® Union Assembly (CSUA)

The CircuitSolver® Union Assembly adds isolation ball valves on either end of the CSU. Assembled and leak tested prior to delivery, the CSUA makes it easier to install and service.

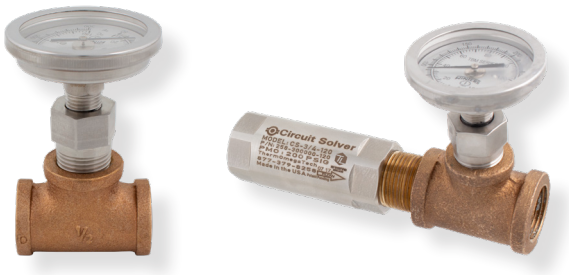


CircuitSolver® Union Strainer Assembly (CSUAS)

The CircuitSolver® Union Assembly is offered with an integrated strainer for water systems with dirt or particulate to facilitate system start up and protect valve components and operation.

CircuitSolver® with ProPress®

CircuitSolver® valves are offered with Viega ProPress® ends for seamless integration into ProPress Systems. Viega Smart Connect technology easily identifies unpressed connection points, saving time and labor costs. The ProPress ends can be equipped to any CircuitSolver® configuration.



CircuitSolver® Thermometer Assembly

The CircuitSolver® thermometer monitors system temperature with an easy-to-read dial for instant hot water temperature verification. Offered in ½", ¾", and 1" sizes, the thermometer assembly can be purchased in any CircuitSolver® configuration or independently.

Model Selection:

CS ___ ___ ___ - ___ - XXX - ___ - ___ - ___

- Blank = standard; U = integrated union
- Blank = standard; A = assembly (2 integrated ball valves)
- Blank = standard; S = strainer
- Line Size
  - All styles: ½", ¾", 1"
  - CS Only: 1¼", 1½", 2"
- Closing Temperature
  - 100°F (37.7°C)
  - 105°F (40.5°C)
  - 110°F (43.3°C)
  - 115°F (46.1°C)
  - 120°F (48.8°C)
  - 125°F (51.6°C)
  - 130°F (54.4°C)
  - 135°F (57.2°C)
  - 140°F (60.0°C)
  - 150°F (65.5°C)
- Blank = standard; CV1 = check valve
- Blank = standard; PP = ProPress ends
- Blank = standard; TW = thermometer

Max. Pressure: 200 PSIG (14 BAR)
Max. Temperature: 250°F (121°C)

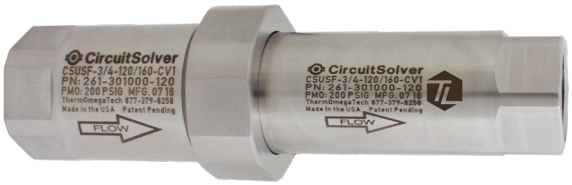
Examples:

1. Standard CircuitSolver® installed on a ½" line with 120°F return temperature: CS-1/2-120
2. CircuitSolver® Union with check valve installed on a ¾" line with 115°F return temperature: CSU-3/4-115-CV1
3. CircuitSolver® Union Strainer Assembly installed on a 1" line with 130°F return temperature: CSUAS-1-130

For product dimensions and specifications, submittals are available at: www.CircuitSolver.com/plumbingspecs

CircuitSolver® Sanitary Flush (CSUSF)

The CircuitSolver® Sanitary Flush allows for higher water temperatures to flow through a domestic hot water system (DHWS) during a disinfecting process to protect against Legionella growth.

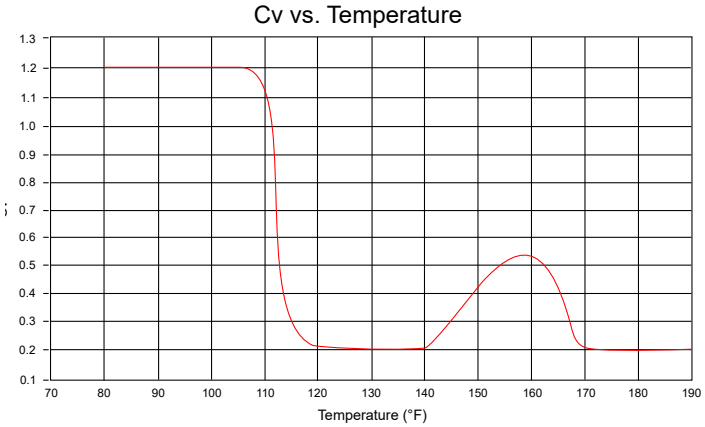


How It Works: The tamper-proof CSUSF uses two thermal actuators to control the flow of water through a branch/riser.

During standard operation of a DHWS, the first (low temperature) actuator balances the system. When the water temperature in the line reaches the set-point of the actuator, the CircuitSolver® modulates to its closed position to keep the hot water at the fixtures. This forces the additional water on to the other branches maintaining a constantly balanced system.

When high temperatures are released into a DHWS during a thermal disinfection process, the low temperature actuator will begin to reopen, allowing the high temperature water to flow through the branch again.

When the water temperature reaches the set-point of the second (high temperature) actuator, the CircuitSolver® modulates to its closed position again to keep the high temperature water at the fixtures.



Model Selection:

During model temperature selection, the first temperature indicates the standard return line temperature and the second temperature indicates the maximum temperature during the sanitary flush process.

CSUSF - __ - XXX/170 - __ - __ - __

- Line sizes: ½", ¾", 1"
- Closing Temperature: 100°F (37.7°C), 105°F (40.5°C), 110°F (43.3°C), 115°F (46.1°C), 120°F (48.8°C), 125°F (51.6°C), 130°F (54.4°C), 135°F (57.2°C), 140°F (60.0°C)
- Blank = standard; CV1 = check valve
- Blank = standard; PP = ProPress ends
- Blank = standard; TW = thermometer

Max. Pressure: 200 PSIG (14 BAR)
Max. Temperature: 250°F (121°C)

Examples:

1. CSUSF installed on a ½" line with 120°F return temperature during standard usage and 170°F return temperature during high temperature flush disinfection process: CSUSF-1/2-120/170.
2. CSUSF with check valve and thermometer installed on a ¾" line with 115°F return temperature during standard usage and 170°F return temperature during high temperature flush disinfection process: CSUSF-3/4-115/170-CV1-TW.

CircuitSolver® GPM & Cv

Valve Size	GPM at 5psi Differential		Cv		
	Open	Closed*	Open	Closed*	Design
1/2"	2.9	0.45	1.3	0.2	0.60
3/4"	4.0	0.45	1.8	0.2	0.85
1"	7.4	0.45	3.3	0.2	1.57
1 1/4"	11.4	0.45	5.1	0.2	2.48
1 1/2"	17.0	0.45	7.6	0.2	3.72
2"	31.8	0.45	14.2	0.2	7.02

CircuitSolver® will never fully close. Built-in bypass leakage eliminates pump deadheading and improves upstream sensitivity.

Flow rate calculation using Cv factor.

$$GPM = C_v\sqrt{\Delta P}$$

$$C_v = \frac{GPM}{\sqrt{\Delta P}}$$

$$\Delta P = \left[\frac{GPM}{C_v}\right]^2$$

Flow and Pressure Drop vs. CircuitSolver®

	Pressure Drop (PSI) per Valve Size at Design Cv					
GPM	1/2"	3/4"	1"	1 1/2"	1 3/4"	2"
0.25	0.17	0.09	0.03	0.01	0.00	0.00
0.5	0.69	0.35	0.10	0.04	0.02	0.01
0.75	1.56	0.78	0.23	0.09	0.04	0.01
1.0	2.78	1.38	0.41	0.16	0.07	0.02
1.25	4.34	2.16	0.63	0.25	0.11	0.03
1.5	6.25	3.11	0.91	0.37	0.16	0.05
1.75	8.51	4.24	1.24	0.50	0.22	0.06
2.0	11.11	5.54	1.62	0.65	0.20	0.08

CircuitSolver® with Variable Speed Drives / ECMs

CircuitSolver® marries well with VSD/ECM pumps since they are both dynamic devices. As the CircuitSolver® approaches the desired return temperature the valve modulates to its closed position which decreases the Cv of the valve and causes an increase in pressure drop.

This increased pressure drop across the VSD/ECM pump serves as a signal to the pump, when set in constant pressure control mode, to decrease its RPM. This results in increased energy efficiency, optimized recirculating flow rate, and reduced chances of producing excessive flow velocity which can cause pipe erosion and pinhole leaks over time. In addition to “constant pressure” control mode, pumps can also be set to a “temperature control mode” and an “adapt mode”.

CircuitSolver® Cold Water Balancing

ThermOmegaTech® offers reverse-acting balancing valves for cold water systems that automatically allows cooler water through the system. For more information on CircuitSolver®’s reverse-acting thermostatic balancing valves, contact our customer support team.

Balancing Return With CircuitSolver®

In periods of no use, domestic hot water recirculation systems act as a closed loop. The mixing valve will utilize the water from only the return line and water heater since no additional cold water can enter the system. If too much of the return flow is directed to the water heater, the water temperature throughout the system will gradually increase until it matches the storage tank temperature. Inversely, if too much of the return flow is directed to the mixing valve, the temperature throughout the system will drop to ambient temperature.

Traditionally, manual balancing valves were installed between the water heater and the return flow into the water heater with a “guesstimate” set flow temperature. However, due to fluctuating pressures in the DHWS, this resulted in temperature creeps and inaccurate results.

The Thermostatic Solution

To replace the downfalls of manual balancing valves, CircuitSolver® uses self-actuating thermostatic valves to effectively eliminate high or low temperature creeps.

When installed on the supply inlet of the return piping to the water heater (Reference the diagram on page 2, valve #2, for proper placement), CircuitSolver® will allow flow back to the water heater in proportion to how cool the return water temperature is relative to the mixing valve output temperature.

The set-point of the CircuitSolver® should equal the desired return temperature. Then when the water temperature reaches that desired return temperature, the CircuitSolver® will close, except for a small bypass, providing minimal flow back to the water heater. As the return water temperature falls below the desired temperature, the CircuitSolver® will open, providing increased flow to the water heater effectively minimizing both positive and negative temperature creep.

To learn more about balancing return with CircuitSolver®, visit www.CircuitSolver.com/Balancing-Return.

CircuitSolver® Compared to Adjustable Thermostatic Balancing Valves

Adjustable thermostatic balancing valves are adjustable over a large temperature range (typically 90˚F to 150˚F). The thermal actuator controlling the valve fully strokes (extends and retracts) over this 50˚F span. This results in a very low Cv over the desired operating range within 5˚F/10˚F of the specified return temperature for a DHWS.

The combination of low Cv and the small change in Cv over a span of 5˚F/10˚F results in a lack of controllability, a high pressure drop across the valve and the potential of not being able to maintain the desired return temperature. This is especially true in branches with high heat loss requiring relatively large flows to reach the desired return temperature.

The table below provides an example for a ¾" CircuitSolver® and a typical ¾" adjustable balancing for a given branch requiring 1.5 GPM to overcome the high heat loss. At a hot water temperature of 10˚F below the desired return temperature, the CircuitSolver® has a Cv of 1.8 and a typical adjustable balancing valve has a Cv of 0.4.

As you will see from the table, under these conditions the CircuitSolver® will have a pressure drop across it of 0.7 PSI while the adjustable balancing valve will have a pressure drop of 14 PSI.

120˚F Return Set-point Temp.	Cv at 110˚F Water Temp.	Flow Rate (GPM)	Pressure Drop (PSI)
CircuitSolver®	1.8	1.5	0.7
Adjustable Balancing Valve (Typ.)	0.4*	1.5	14

**Due to the high pressure drop of the adjustable thermostatic balancing valve and the potential for a limited pressure drop across the branch there is a possibility that the stated flow rate may not be achieved.*

This scenario provides the plumbing designer with two, not very desirable, options:

1) Ignore the high pressure drop required to develop enough flow to overcome the heat loss resulting in the inability to maintain the desired return temperature.

2) Specify a pump with a significantly higher head pressure, significantly increasing the pump's size, cost and energy usage while putting an additional burden on the system.

CircuitSolver® is the leader in thermostatic balancing with thousands of successful installations over the last 9+ years.

Often portrayed as an advantage, adjustable balancing valves actually hinder a DHWS's performance which is why CircuitSolver® is proud to be the only fixed return temperature balancing valve on the market.

The attribute table to the right demonstrates our commitment to product enhancements in response to the needs of engineers and contractors and the overall advantage of specifying/installing CircuitSolver® balancing valves.

Attributions	CircuitSolver®	Typical Adjustable Balancing Valve
Adjustability	✗	✓
Tamper Proof	✓	✗
Union	✓	✗
Integrated Check Valve	✓	✗
Sizes	1/2", 3/4", 1", 1 1/4", 1 1/2", 2"	1/2", 3/4"
ProPress Ends	✓	✗
Assemblies	✓	✗
Thermal Disinfection	✓	✓

CircuitSolver® FAQ's

What is the pressure drop across a CircuitSolver®?
To get a basic approximation for the pressure drop across the CircuitSolver® within a given branch, utilize the following equation where Cv = design Cv and flow is the estimated flow to offset heat loss in the branch:

For this example – Cv = .85 (design Cv for ¾" CircuitSolver®) Flow = 1 GPM (estimated flow to offset heat loss in a given branch)
$\Delta P = [GPM/Cv]2 = [1/.85]2 = 1.4$ psi

CircuitSolver® is not in a fixed position, it opens and closes based on water temperature. Because of the varying position how do I size a recirculating pump?
You do not size a recirculating pump any differently when using CircuitSolver® valves compared to other balancing valves other than possibly reduce the safety factor you may presently employ. A recirculating pump's purpose is to produce enough flow throughout the DHWR system to overcome heat loss. ASPE and ASHRAE have guidelines as to how to calculate the heat loss in the system. This calculation does not change based on the type of balancing valve used – You calculate the flow required to offset heat loss in the DHWR, taking into account the ΔT from the hot water source to the last fixture. The CircuitSolver® valves will balance their position to adjust the flow in the given branch to offset the heat loss.

Does CircuitSolver® shut off tightly?
No, there is a small leakage (0.2 GPM) built into CircuitSolver® even when "closed". This is done so the distribution branches are not completely dead ended. In some applications where the water distribution piping is occasionally chemically or thermally sterilized, this leakage allows enough flow through the system to accomplish the cleaning, regardless of temperature.

Does a dielectric union/coupling need to be used with CircuitSolver®?
No, we have not seen or heard of any case where dissimilar metals between CircuitSolver® valves and copper or brass piping, tubing, or other valves has caused galvanic corrosion. DHWR systems are not stagnated or in a low flow status long enough to allow this problem to occur.

Do I need to use a strainer with CircuitSolver®?
In general, No. Since it is used in potable water systems, particles in the water should already be removed. If there is a history of particulates causing problems in the domestic hot water system, then a strainer is recommended. In some cases, strainers have also been used as part of a startup protocol to remove most particulate that can get in the lines during construction. After startup, the filter in the strainer is sometimes removed. ThermOmegaTech® offers CircuitSolver® configurations pre-assembled with a strainer (CSUAS) for systems that need it.

Why CircuitSolver®?

- Temperature solution to a temperature problem
- Compliant with the Buy America Act
- Manufactured in Warminster, PA
- Lead free & NSF 61 Certified
- Long service life & 3 year warranty
- Direct replacement for manual balancing
- Tamper Proof - Fixed set-point
- Stainless steel - corrosion resistant
- Range of sizes ½", ¾", 1", 1¼", 1½" & 2"
- Array of configurations available
- High Cv

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