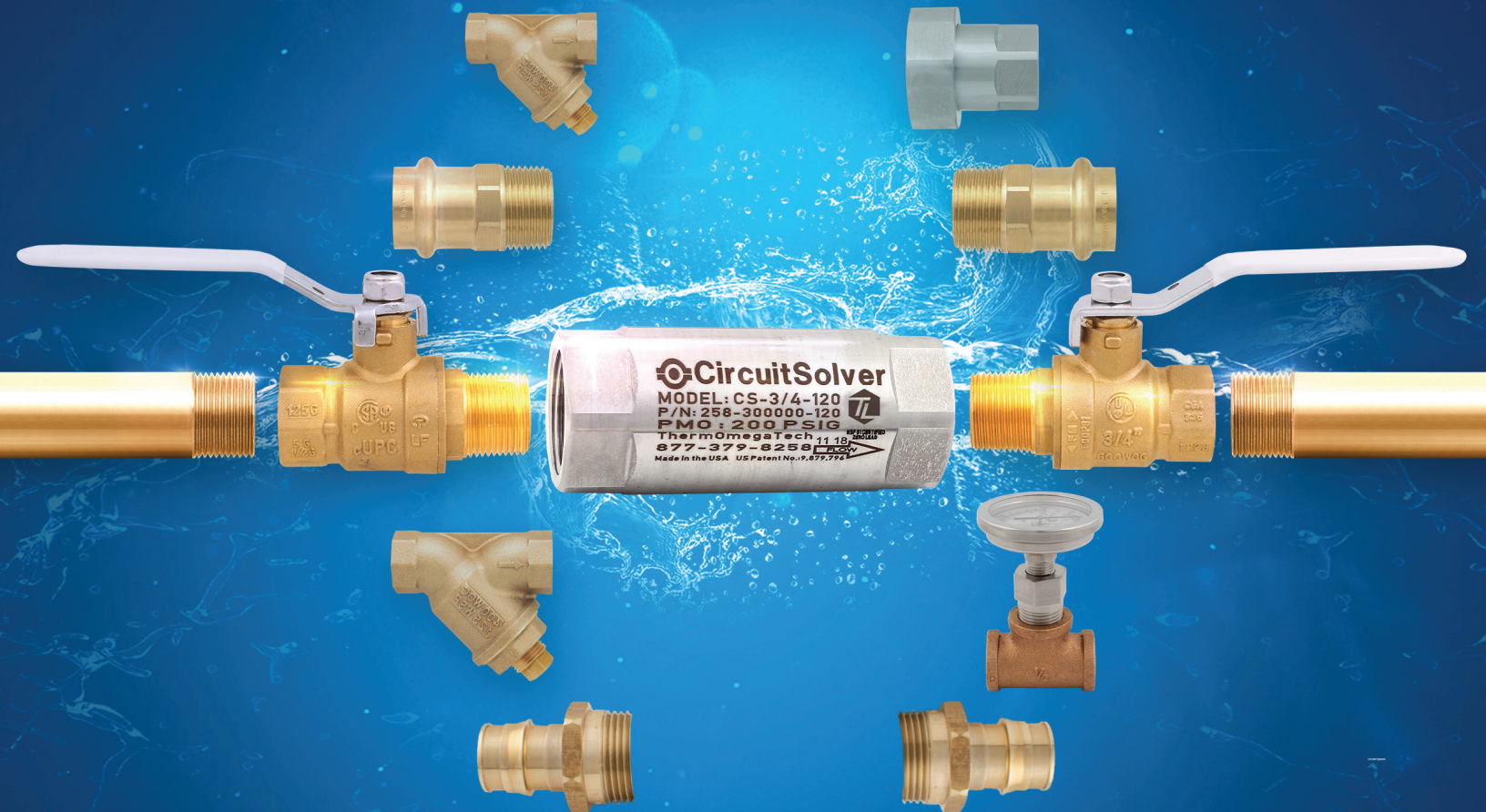


Embrace the Technology[®]

 **CircuitSolver[®]**

A ThermOmegaTech[®] brand

Thermostatic Balancing Valves For Domestic Hot Water Systems



Offered in a variety of sizes from 1/2" to 2" with configurations including ball valves, integrated unions, check valves, strainers, thermometers, and ProPress ends

All CircuitSolver[®] Valves
are NSF/ANSI 61 Certified

CircuitSolver.com
1-877-379-8258

ThermOmegaTech's QMS is certified to the AS9100D 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 to ensure that hot water is available throughout a building on every floor, at every fixture, at all times.

The Problem: A building typically requires 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.

Note: The valve never fully closes, allowing a small amount of bypass flow to the return to avoid deadheading the recirculation pump.

CircuitSolver[®] Placement Do's and Don'ts

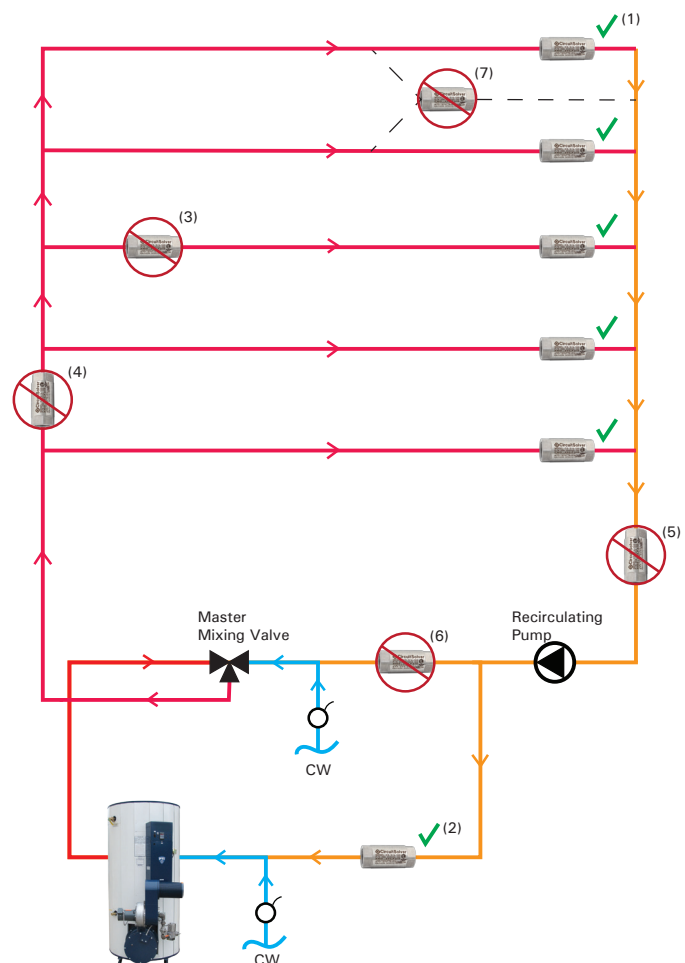
- (1) ✓ at the end of each branch/riser
- (2) ✓ in the return line back to the water heater
- (3) ✗ not in the middle of a branch/riser
- (4) ✗ not in a supply line
- (5) ✗ not in the return line
- (6) ✗ not after the recirculating pump
- (7) ✗ don't combine 2 branches/ risers

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.



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 features a union with an integrated O-ring for a leak-free seal and an optional integrated check valve to reduce the number of system components to be installed and minimize potential leak points.

CircuitSolver[®] Union Assembly (CSUA)

The CircuitSolver[®] Union Assembly adds isolation ball valves on either end of the CSU, further reducing leak points. Assembled and leak tested before 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[®] with ProPEX[®]

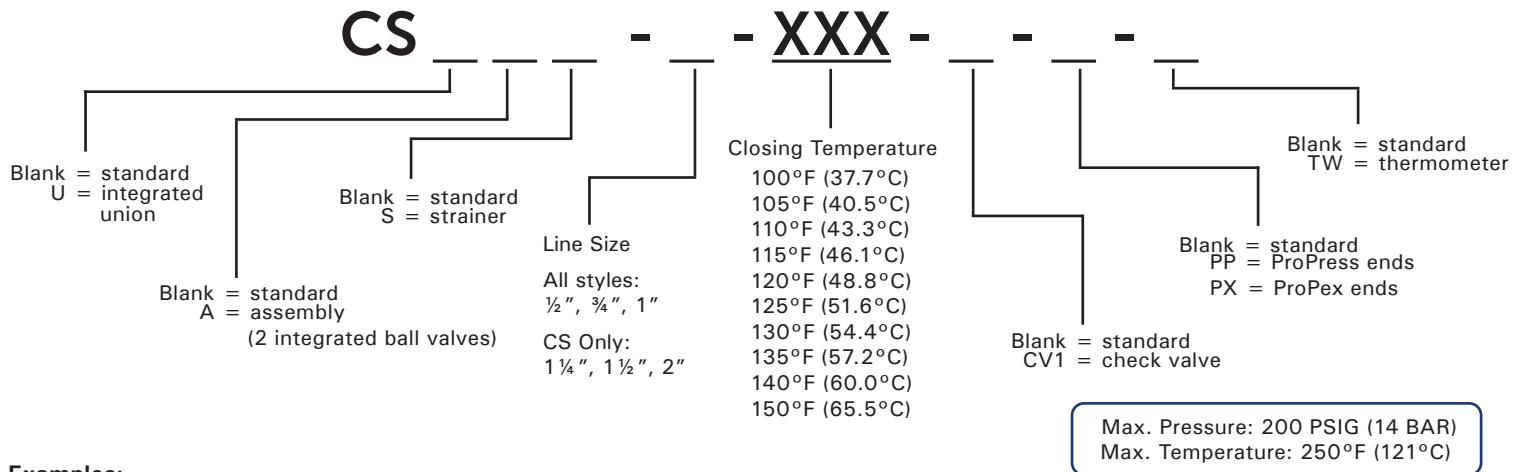
CircuitSolver[®] valves are offered with ProPEX[®] ends for seamless integration into ProPEX[®] Systems. The ProPEX[®] ends can be equipped to any CircuitSolver[®] configuration.

CircuitSolver[®] Thermometer Assembly

The CircuitSolver[®] thermometer monitors system temperature with an easy-to-read dial for instant hot water temperature verification. Offered in 1/2", 3/4", and 1" sizes, the thermometer assembly can be purchased in any CircuitSolver[®] configuration or independently.



Model Selection:



Examples:

- Standard CircuitSolver® installed on a ½" line with 120°F return temperature: CS-1/2-120
- CircuitSolver® Union with check valve installed on a ¾" line with 115°F return temperature: CSU-3/4-115-CV1
- 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® Union Thermal Disinfection (CSUTD-D)

The CircuitSolver® Union Thermal Disinfection Dual Balancing valve has two thermal actuators to balance a domestic hot water system (DHWS) during a disinfecting process to protect against Legionella growth.



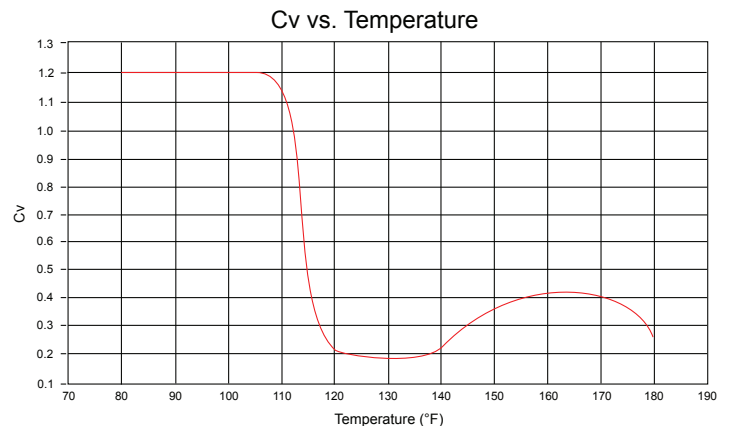
How It Works: During normal conditions of a DHWS, the first (low temperature) actuator balances the system.

When the water temperature in the line reaches the set-point of the actuator, the CSUTD-D modulates to its closed position to keep the hot water at the fixtures. This forces the additional water onto 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 CSUTD-D modulates to its closed position again to keep the high temperature water at the fixtures.

This dual balancing thermal disinfection valve is typically used when the entire domestic hot water system is being thermally disinfected at once. This provides the opportunity to limit the amount of flow of the 160°F disinfection temperature water as it approaches 170°F in each branch/riser.



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.

CSUTD -D- - 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
TW = thermometer

Blank = standard
PP = ProPress ends
PX = ProPex ends

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

Examples:

- CSUTD-D installed on a ½" line with 120°F return temperature during standard usage and 170°F return temperature during high temperature flush disinfection process: CSUTD-D-1/2-120/170.
- CSUTD-D 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: CSUTD-D-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.

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

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

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

Flow and Pressure Drop vs. CircuitSolver®

GPM	Pressure Drop (PSI) per Valve Size at Design Cv					
	1/2"	3/4"	1"	1 1/4"	1 1/2"	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”.

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 the return line and water heater since no additional cold water can enter the system. If flow is not managed correctly, the water temperature throughout the system can gradually increase or decrease.

Conventionally the way to solve this issue is by installing a manual balancing valve between the water heater and the return flow into the water heater with a “guesstimate” set flow temperature. However, fluctuating pressures in the domestic hot water system can result in temperature creeps and inaccurate results.

The Thermostatic Solution

A better approach is to use a thermostatic valve in place of the manual balancing valve. The self-actuating CircuitSolver[®] valves eliminate high or low-temperature creeps by maintaining a set water temperature. 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), the CircuitSolver[®] valve 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.

As the return water temperature falls below the desired temperature, the valve 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 [CircuitSolver.com/Balancing-Return](https://www.circuitsolver.com/Balancing-Return).

CircuitSolver[®] Cold Water Balancing

To discourage Legionella bacteria growth, cold water systems in commercial buildings should be recirculated and adequately balanced to establish continuous flow and keep line temperatures below 68°F (20°C) - the point at which Legionella begins to colonize.

ThermOmegaTech[®] offers reverse-acting balancing valves for cold water recirculation systems to maintain a set temperature which discourages Legionella bacteria colonization, reduces stagnation, and ensures “residual chlorine” is distributed throughout the system. For more information on the need for recirculating cold water and CircuitSolver’s cold water thermostatic balancing valves, visit [CircuitSolver.com/CSU_CW](https://www.circuitsolver.com/CSU_CW).

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 resulting in a very low Cv over the desired operating range within 5°F/10°F of the specified return temperature for a domestic hot water recirculation system.

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 significantly higher head pressure, considerably 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 10+ years.

Often portrayed as an advantage, adjustable balancing valves 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 a CircuitSolver[®] valve 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. How do you size the recirculation pump when using a CircuitSolver[®]?

Use the industry-standard plumbing engineering guidelines, for example, as shown in the ASHRAE handbook, to calculate system heat loss and system friction loss which will facilitate pump sizing. There is no need to oversize the pump to compensate for other factors.

Does CircuitSolver[®] shut off tightly?

No, there is a small leakage (0.2 GPM) built into CircuitSolver[®] valves 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.

Can CircuitSolver[®] valves be installed in any orientation?

Yes, CircuitSolver[®] valves will function properly in any orientation. However, valves with an integrated check valve must be installed with the flow arrow pointing in the correct direction (towards the return line).

What are the advantages of the CSU – CircuitSolver[®] with union and an optional check valve?

The CSU is an integrated solution incorporating a union with an "o" ring face seal and an optional check valve. By having the union and check valve integrated, you save cost and labor, reduce the number of potential leak points, and have a more compressed, reliable assembly.

Why CircuitSolver[®]?

- Temperature solution to a temperature problem
- Compliant with the Buy America Act
- 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", 1 ¼", 1 ½" & 2"
- Array of configurations available
- High Cv