



# Instruction Sheet

## iSeries - Outdoor Reset (iSeries-R) 2-Way, 3-Way and 4-Way iSeries Mixing Valves

102-145

SUPERSEDES: August 15, 2005

EFFECTIVE: June 1, 2009

Plant ID# 001-1025

**WARNING: Do not use iSeries products for potable water tempering or in any application where scalding can occur as a result of exposure to the tempered water.**

The iSeries-R is a microprocessor-based valve designed to regulate the supply water temperature to a heating system by modulating the position of an iSeries Mixing Valve. The iSeries-R operates the valve to provide outdoor reset to the heating system. A boiler sensor installed on the return line to the boiler is used to protect the boiler against flue gas condensation.

### Outdoor Reset

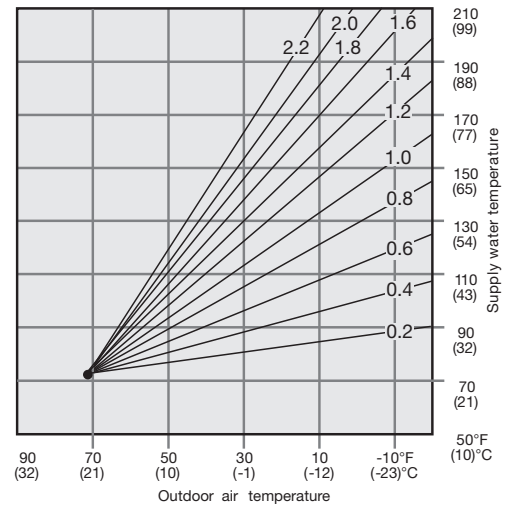
In order to properly control a hot water heating system, the heat supplied to the building must equal the heat lost by the building.

- The heat supplied to the building is directly proportional to the temperature of the water and the surface area of the heating element. The higher the temperature of the water flowing through the heating terminal, the higher the heat output.
- The heat lost from a building is dependent on the outdoor temperature. As the outdoor temperature drops, the building heat loss increases.

These two facts lead to the concept of outdoor reset which increases the supply water temperature as the outdoor temperature drops. Using this approach, the heat lost from the building is matched by the heat provided by the terminal units, therefore providing more comfort and energy savings.

### Reset Ratio

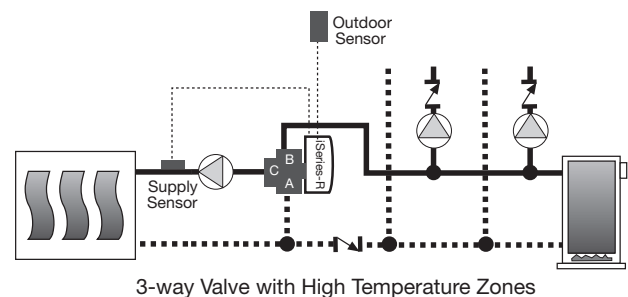
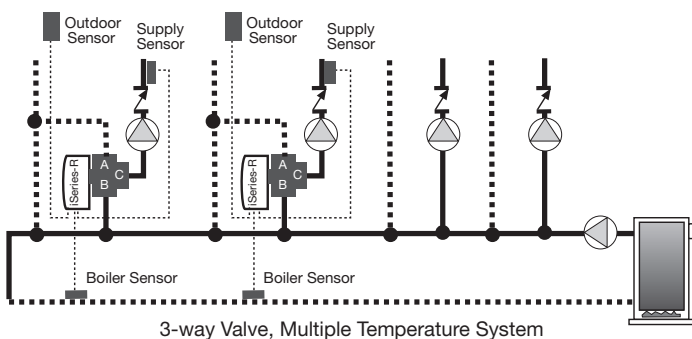
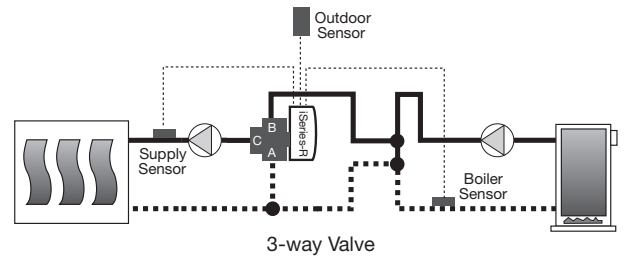
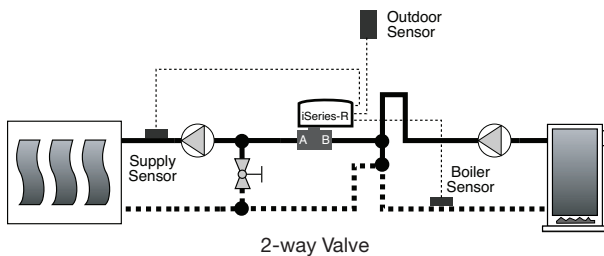
The Reset Ratio sets the relationship between outdoor temperature and supply water temperature. It determines the amount the supply water temperature is raised for every 1 degree outdoor temperature drop. For example, if a Reset Ratio of 1.2 is selected, the supply water temperature is increased by 1.2 degrees of every 1 degree of outdoor temperature drop.

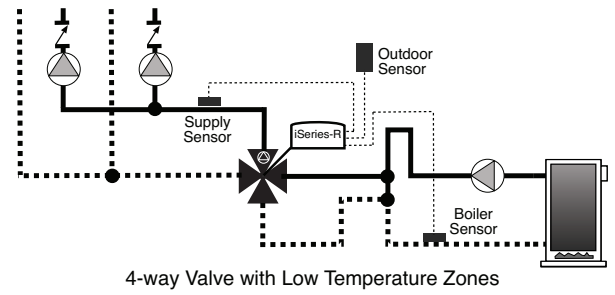
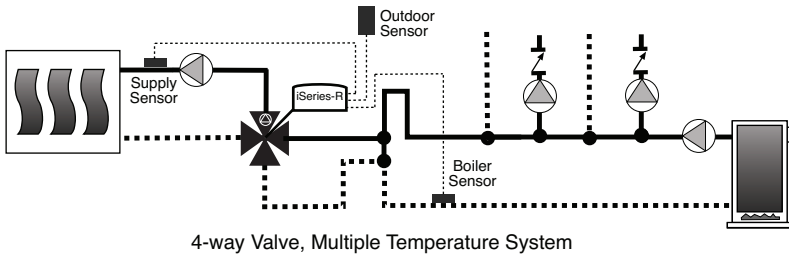


### 2-Way / 3-Way / 4-Way Mixing

An iSeries Mixing Valve may be used to mix the hot boiler water temperature with the cooler return water temperature from the system loop. The position of the iSeries Mixing Valve is modulated in order to inject different rates of hot water into the cool system return water. This allows for virtually any water temperature to be supplied to the heating system. When deciding between a 2-way, 3-way or 4-way valve, maximum flow rates must be considered. See the charts on page 2 and 3 before selecting style of valve / piping.

Most boilers cannot operate at low temperatures, therefore the iSeries-R can be modulated back in order to prevent the boiler from operating at cold temperatures, by installing the boiler return sensor.

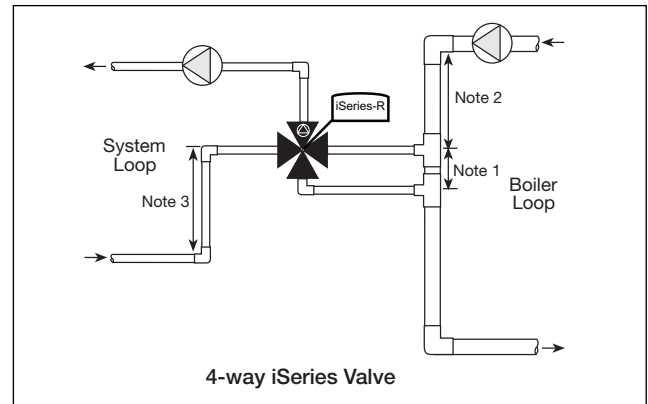
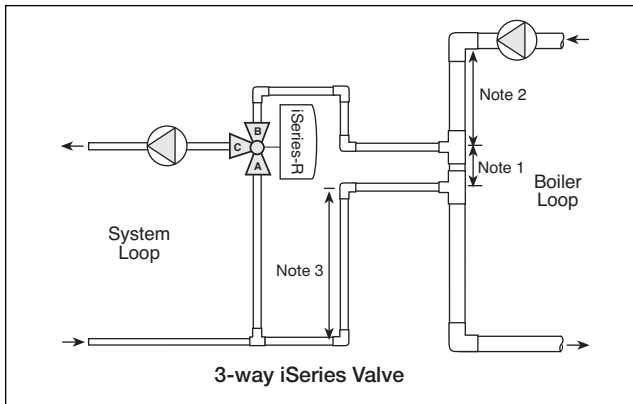
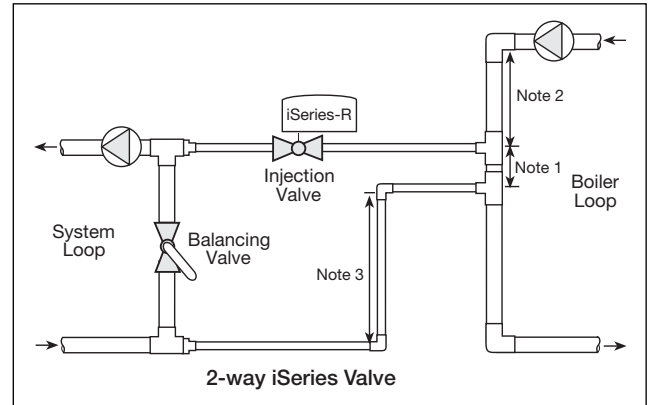




## Design

When using an iSeries-R Mixing Valve, the following piping requirements must be considered for proper operation.

1. In order to hydraulically isolate the boiler loop from the injection or system loop primary/secondary piping must be used. There must be no more than 4 pipe diameters between the tees in the boiler loop (Note 1).
2. There must be at least 6 pipe diameters of straight pipe on either side of the tees (Note 2) in order to prevent the momentum of water in the boiler loop from pushing flow through the injection loop.
3. There should be a minimum of 1 foot drop on the return pipe of the injection loop, in order to create a thermal trap (Note 3) and prevent unwanted heat transfer.
4. When using a 2-way iSeries-R Mixing Valve, a balancing valve must be located between the tees in the system loop, in order to provide a pressure drop to induce flow through the mixing loop.



## 2-Way iSeries Mixing Valve Selection

In order to properly size the 2-way iSeries Mixing Valve, follow the design procedure below:

- 1) Determine the design radiant heating load.
- 2) Determine the design boiler supply temperature.
- 3) Determine the radiant system return temperature which is based on the design temperature drop across the radiant system.
- 4) Determine the design injection flow rate using the following equation:

$$\text{Eq. 1: Design Injection Flow Rate (US GPM)} = \frac{\text{Design Radiant Heating Load (BTU/hr)}}{500 \times (\text{Boiler Supply} - \text{Radiant System Return})}$$

- 5) From the 2-way Cv chart below, select the valve size with the closest Cv value to the design injection flow rate calculated in step 4.

iSeries: 2-way Cv	
Size	Cv
1/2"	4.9
3/4"	10.3
1"	8.9

### 3-Way / 4-Way iSeries Mixing Valve Selection

Select the 3-way or 4-way iSeries Mixing Valve based on the Pressure Drop charts below.

iSeries 3-way Valve Pressure Drop												
Flow GPM	1/2" Sweat & Threaded C <sub>v</sub> = 1.5		1/2" Union C <sub>v</sub> = 3.5		3/4" Sweat & Threaded C <sub>v</sub> = 3.5		3/4" Union C <sub>v</sub> = 4.5		1" Sweat & Threaded C <sub>v</sub> = 4		1" Union C <sub>v</sub> = 4.5	
	PSI	Ft. Head	PSI	Ft. Head	PSI	Ft. Head	PSI	Ft. Head	PSI	Ft. Head	PSI	Ft. Head
1/2	0.11	0.26	0.02	0.05	0.02	0.05	0.01	0.03	0.02	0.04	0.01	0.03
1	0.44	1.03	0.08	0.19	0.08	0.19	0.05	0.11	0.06	0.14	0.05	0.11
2	1.78	4.10	0.33	0.75	0.33	0.75	0.20	0.46	0.25	0.58	0.20	0.46
4	—	—	1.31	3.01	1.31	3.01	0.79	1.82	1.00	2.31	0.79	1.82
6	—	—	2.94	6.78	2.94	6.78	1.78	4.10	2.25	5.19	1.78	4.10
8	—	—	5.22	12.05	5.22	12.05	3.16	7.29	4.00	9.23	3.16	7.29
10	—	—	—	—	—	—	4.94	11.39	6.25	14.42	4.94	11.39
12	—	—	—	—	—	—	7.11	16.41	—	—	7.11	16.41

iSeries 4-way Valve Pressure Drop						
Flow GPM	3/4" C <sub>v</sub> = 7.0		1" C <sub>v</sub> = 9.3		1 1/4" C <sub>v</sub> = 17.5	
	PSI	Ft. Head	PSI	Ft. Head	PSI	Ft. Head
1/2	0.01	0.01	0.00	0.01	0.00	0.00
1	0.02	0.05	0.01	0.03	0.00	0.01
2	0.08	0.19	0.05	0.11	0.01	0.03
4	0.33	0.75	0.18	0.43	0.05	0.12
6	0.73	1.69	0.42	0.96	0.12	0.27
8	1.31	3.01	0.74	1.71	0.21	0.48
10	2.04	4.71	1.16	2.67	0.33	0.75
12	2.94	6.79	1.66	3.84	0.47	1.08
14	4.00	9.24	2.28	5.27	0.64	1.48
16	—	—	2.96	6.84	0.84	1.93
18	—	—	3.76	8.70	1.06	2.44
20	—	—	—	—	2.30	5.31

### Sequence of Operation

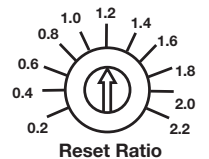
#### Power Up and Heat Request

Whenever the iSeries-R is powered up, the LED turns green and the control starts operation. The power to the iSeries-R may be switched through an end switch (e.g. Taco ZVC/SR style zone control), a thermostat for intermittent operation, or the power source may be connected directly to the iSeries-R for continuous operation.

#### Reset Ratio

Once the iSeries-R is powered up, it provides outdoor reset at the supply sensor location. The iSeries-R targets a supply temperature based on the outdoor temperature measured and the Reset Ratio dial setting. The Reset Ratio is set using the following formula:

$$\text{Reset Ratio} = \frac{\text{Design Supply Temperature} - 72^{\circ}\text{F}}{72^{\circ}\text{F} - \text{Design Outdoor Temperature}}$$

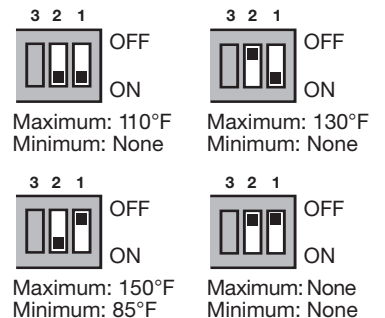


#### Maximum/Minimum System Supply Temperature (DIP switch 1 & 2)

The iSeries-R has a maximum supply function used to set a maximum supply water target temperature. This function helps to protect system components, such as floor coverings, by preventing excessive water temperatures. The maximum target temperature is selected using DIP switches 1 & 2.

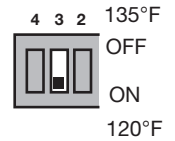
When selecting a maximum supply target temperature of 150°F, the iSeries-R also enables a minimum supply target temperature of 85°F. This function is typically used in staple up radiant floor heating applications, in order to ensure enough heat delivery during mild outdoor temperatures.

If the actual supply water temperature approaches the maximum or minimum system supply, the iSeries-R modulates the valve down and the green LED flashes rapidly (reduced output).



### Minimum Boiler Return Temperature (DIP switch 3)

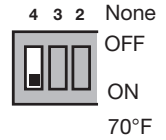
The iSeries-R includes a boiler protection function which prevents low temperatures back to the boiler. Whenever the boiler sensor is installed, the iSeries-R monitors the boiler return temperature and modulates the valve down when the return temperature is near the minimum setting. The minimum setting is selected via DIP switch 3. When the switch is turned on, the minimum temperature is set to 120°F and when the DIP is turned off the minimum temperature is 135°F.



When using low temperature boilers such as condensing or electric, the boiler minimum temperature may be disabled by powering up the control without a boiler return sensor. Whenever the iSeries-R is being modulated towards the closed position to protect the boiler, the green LED flashes rapidly (reduced output).

### Warm Weather Shut Down (WWSD) (DIP switch 4)

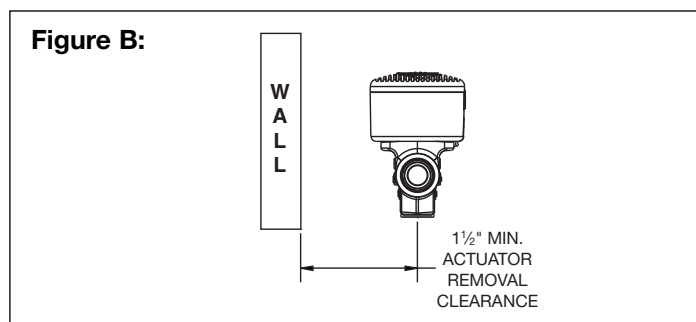
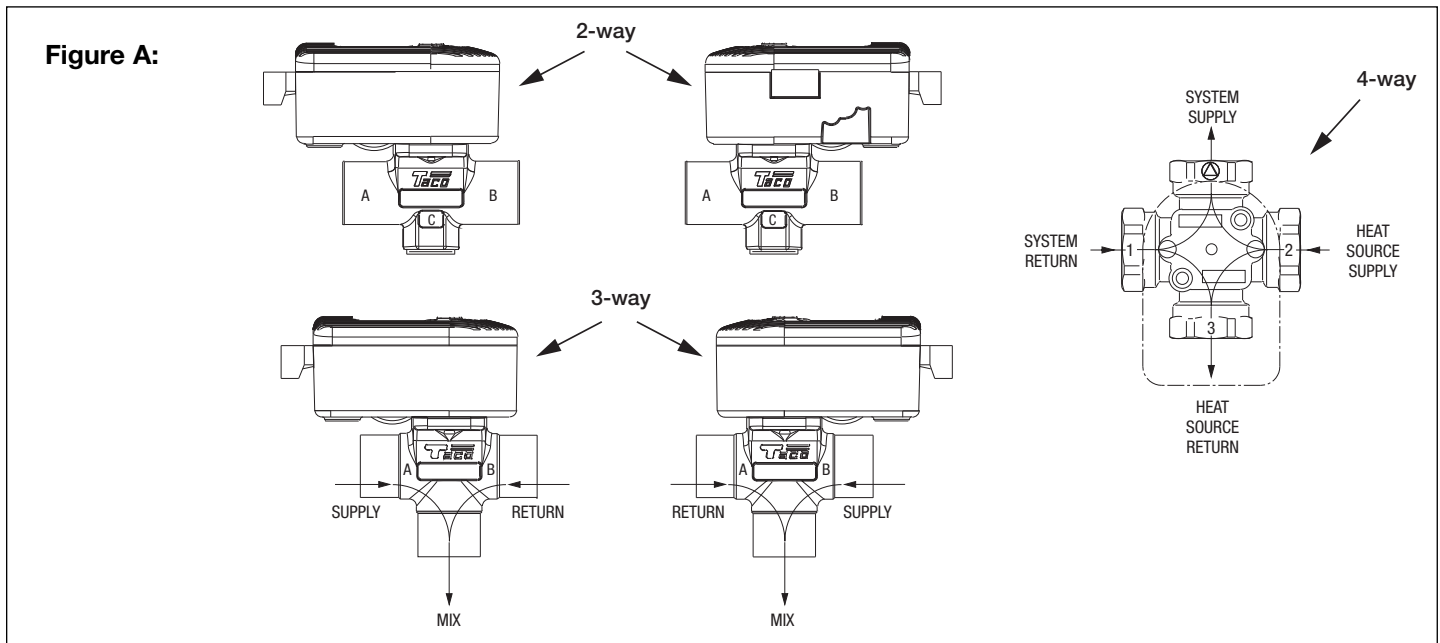
When the outdoor temperature is warmer than 70°F, the iSeries-R closes. The green LED then slowly flashes during warm weather shut down. This function may be turned on by setting the DIP switch 4 to the on position.



### Valve Installation

**WARNING: Actuator must be removed from the valve body before soldering. Ball valve must be in the full open position before soldering. Valve is shipped in the full closed position.**

1. Valve body may be installed in any position, in any orientation (see Figure A). 3-way actuator's power connections must be over the supply port to ensure proper flow direction (see Figure A).
2. Before mounting body, refer to Figure B and Dimensions Section for clearances.
3. Use of a lead or tin based solder with a melting point below 600°F is recommended. Do not overheat. Make sure the ball valve is in the **FULL OPEN** position during soldering. Direct flame tip away from the center of the valve. Cool valve quickly with a wet rag.
4. Solder build-up on the ball valve may prevent proper opening and closing of the valve. Rotate the manual operation button several times to loosen any possible build-up.
5. Valve body can be submerged for leak testing before the actuator is attached.



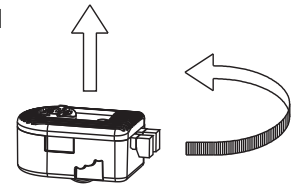
## Actuator Installation / Removal

1. Valve actuator may be attached to the valve body in either direction (see Figure A). The 3-way actuator must be attached with the power connections over the supply port to ensure proper flow direction (see Figure A).
2. Actuator removal: Remove valve actuator prior to soldering by rotating the actuator counterclockwise approximately 30 degrees and lifting upward approximately 3/4" (see Figure C).
3. To re-assemble actuator to valve body: Position actuator such that the "D" shaped valve stem aligns properly with the "D" shaped actuator drive cavity (Note: The "D" shaped stem design allows for correct insertion every time). Next, slide valve stem into actuator cavity and rotate until the actuator slips over the valve's locking posts (see Figure C), once the actuator is flush with valve body, turn actuator clockwise and lock into position.

**Figure C: Actuator Removal**

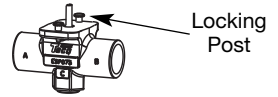
**Step 1**

Rotate actuator counterclockwise approximately 30 degrees



**Step 2**

Move actuator upward 3/4" to disengage



## Wiring and Sensor Installation

**WARNING: Wiring connections must be made in accordance with all applicable electrical codes.**

**CAUTION: To prevent electrical shock, disconnect electric power to system at main fuse or circuit breaker box until installation is complete. When a service switch is installed, more than one disconnect switch may be required to deenergize this device for servicing.**

All terminals provided with the iSeries-R are removable. In order to prevent damage to the electronics, disconnect all plugs before the power is turned on and check voltages and sensors. Once the circuits are tested, plug in the terminals.

### Powering the Control

For intermittent operation, connect one side of the end switch (e.g. Taco ZVC/SR series zone control) or thermostat to an external 24 V (ac) transformer. Connect the other side of the zone control's end switch to the R terminal on the iSeries-R. The C terminal must then be connected to the other side of the transformer. For continuous operation, simply wire the transformer directly to the R and C terminals on the iSeries-R. Ensure that no power is present during this process.

### Sensors

Do not apply power to these terminals as this will damage the iSeries-R. The wiring terminals for the sensors may be removed for ease of installation.

#### Outdoor Sensor

Remove the screw and pull the front cover off the sensor enclosure.

The outdoor sensor can either be mounted directly onto a wall or in a 2" x 4" electrical box. When the sensor is wall mounted, the wiring should enter through the back or bottom of the enclosure. Do not mount the sensor with the conduit knockout facing upwards as rain could enter the enclosure and damage the sensor.

In order to prevent heat transmitted through the wall from affecting the sensor reading, it may be necessary to install an insulating barrier behind the enclosure.

The sensor should be mounted on a wall which best represents the heat load on the building (a northern wall for most buildings and a southern facing wall for buildings with large south facing glass areas). The sensor should not be exposed to heat sources such as ventilation or window openings. The sensor should be installed at an elevation above the ground that will prevent tampering.

Connect 18 AWG or similar wire from the outdoor sensor directly into the SENSOR COMMON and OUTDOOR terminals on the iSeries-R. Replace the front cover of the sensor enclosure.

#### System Supply and Boiler Return Sensors

The sensors can be strapped directly to the pipe using a cable tie. Insulation should be placed around the sensor to reduce the effect of air currents on the sensor measurement. The sensors should be placed downstream of a pump or after an elbow or similar fitting. This is especially important if large diameter pipes are used because the thermal stratification within the pipe can result in erroneous sensor readings. Proper sensor location requires that the fluid is thoroughly mixed within the pipe before it reaches the sensor.

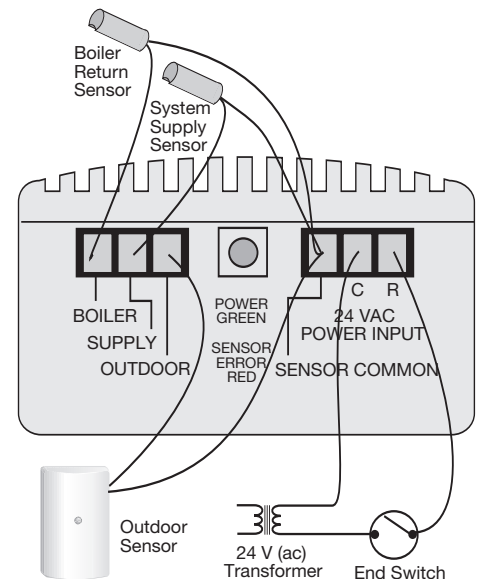
If the System Supply Sensor is used to measure duct temperature, the sensor should be mounted in such a manner that it measures the average duct outlet temperature.

#### System Supply Sensor

Connect the two wires from the supply sensor directly into the SENSOR COMMON and SUPPLY terminals on the iSeries-R.

#### Boiler Return Sensor

Connect the two wires from the boiler return sensor directly into the SENSOR COMMON and BOILER terminals on the iSeries-R.



## Troubleshooting

As in any troubleshooting procedure, it is important to isolate a problem as much as possible before proceeding. The error messages greatly simplify troubleshooting of the iSeries-R. When the control flashes an error message, identify the fault and follow standard testing procedures to confirm the problem. If you suspect a wiring fault, return to the wiring section on this brochure and carefully check all external wiring and wiring connections.

### Multi-Status LED

LED	LED Status	iSeries-R Status
Green	Solid	Power On
Green	Slow Flash	Warm Weather Shut Down
Green	Fast Flash	Reduced Output (boiler protection activated)
Red	Flash, Pause, Flash, Pause, etc.	System Supply Sensor Fault. If any of the system supply maximum DIP switches (DIP 1 & 2) are on, the iSeries-R closes. However, if the maximum supply DIP switches are off, the iSeries-R operates at an output of 10%.
Red	Flash, Flash, Pause, Flash, Flash, Pause, etc.	Boiler Sensor Fault. The iSeries-R ignores the boiler protection function.
Red	Flash, Flash, Flash, Pause, Flash, Flash, Flash, Pause, etc.	Outdoor Sensor Fault. The iSeries-R assumes an outdoor temperature of 32°F.

### Adjustment of Settings

If the outdoor temperature is cold and the building is cold, increase the Reset Ratio setting by one notch per day.

### Testing the Sensors

A good quality test meter capable of measuring up to 5,000 k $\Omega$  (1 k $\Omega$  = 1000  $\Omega$ ) is required to measure the sensor resistance. In addition to this, the actual temperature must be measured with a good quality digital thermometer.

First measure the temperature using the thermometer and then measure the resistance of the sensor at the iSeries-R. The wires from the sensor must not be connected to the iSeries-R while this test is performed. The wiring terminals are easily removed by pulling them from the iSeries-R. Using the chart below, estimate the temperature measured by the sensor. The sensor and thermometer readings should be close. If the test meter reads a very high resistance, there may be a broken wire, a poor wiring connection or a defective sensor. If the resistance is very low, the wiring may be shorted, there may be moisture in the sensor or the sensor may be defective. To test for a defective sensor, measure the resistance directly at the sensor location.

Temperature		Resistance	Temperature		Resistance	Temperature		Resistance	Temperature		Resistance
°F	°C	$\Omega$	°F	°C	$\Omega$	°F	°C	$\Omega$	°F	°C	$\Omega$
-30	-34	234,196	30	-1	34,558	90	32	7,334	150	66	2,045
-20	-29	165,180	40	4	26,099	100	38	5,828	160	71	1,689
-10	-23	118,018	50	10	19,900	110	43	4,665	170	77	1,403
0	-18	85,362	60	16	15,311	120	49	3,760	180	82	1,172
10	-12	62,465	70	21	11,883	130	54	3,050	190	88	983
20	-7	46,218	80	27	9,299	140	60	2,490	200	93	829

## Product Specifications

Maximum Operating Pressure:	300 PSI (2,100 kPa)
Maximum Shutoff Pressure:	125 PSI (875 kPa)
Fluid Temperature Range:	20° to 240°F, (-7° to 115°C) @ 135°F (57°C) ambient
Service:	Closed systems Hot and Chilled Water, up to 50% Glycol
Seat Leakage:	Drop-Tight Close-Off
Electrical Rating:	24 VAC $\pm$ 10%, 60 Hz Do not exceed number of valves per transformer rating. Example: Do not use more than 5 iSeries Mixing Valves per 40VA transformer.
Power Consumption:	7.2 Watts, 0.3 Amps

## Flow Coefficients

Valve Size	2-way $C_v$ (Kv)/Ft. of Pipe Equiv.*	3-way $C_v$ (Kv)/Ft. of Pipe Equiv.*		4-way $C_v$ (Kv)/Ft. of Pipe Equiv.*
		Sweat & Threaded	Union	
1/2"	4.9 (4.3) / 9.5	1.5 (3.0) / 18.6	3.5 (3.0) / 18.6	—
3/4"	10.3 (8.9) / 8.4	3.5 (3.0) / 73.0	4.5 (3.9) / 44.2	7.0 (6.1) / 19
1"	8.9 (7.7) / 47.4	4.0 (3.5) / 234.9	4.5 (3.9) / 185.6	9.3 (8.1) / 44
1 1/4"	—	—	—	17.5 (15.2) / 26

\* At 4' per second (maximum recommended residential flow rate).

## Materials of Construction, Actuator

Body: High Performance Engineered Polymer  
 Gears: High Performance Internally Lubricated Engineered Polymer

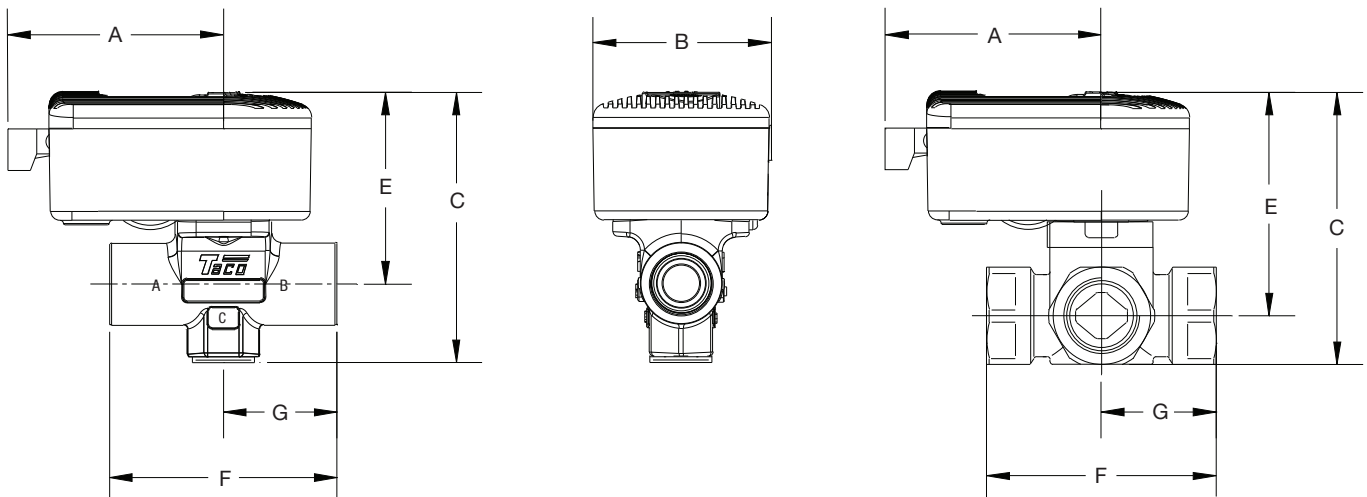
## Materials of Construction, Valve

Body: Forged Bronze  
 Stem: Brass  
 Press Ring: Brass  
 Ball: Brass (Chrome Plated)  
 Seat (2, 3-way): Modified Teflon  
 O-rings: EPDM

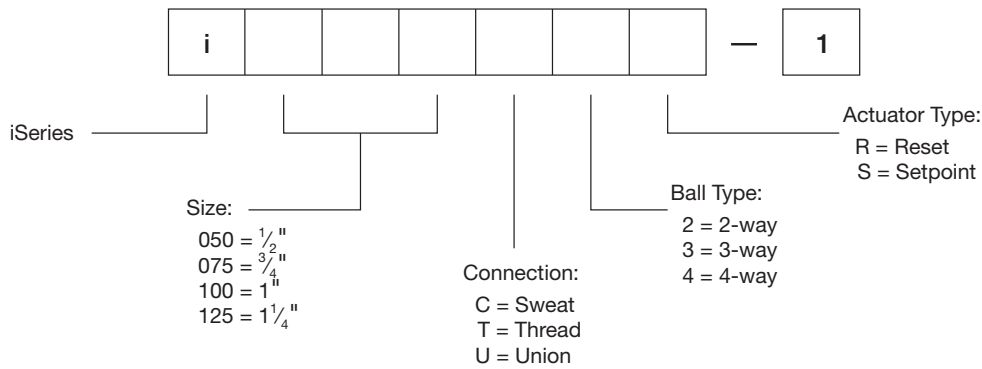
## Dimensions

Valve Size	A	B	C				E			F		Weight (lbs) / $C_v$			
			2-way	3-way	3*-way, U	4-way	2&3-way	3*-way, U	4-way	3*-way, U	4-way	2-way	3-way	3*-way, U	4-way
1/2"	3"	2 3/8"	3 9/16"	4 9/16"	5 3/16"	—	2 9/16"	2 9/16"	—	4 1/4"	—	1.15/4.9	1.25/1.5	1.45/3.5	—
3/4"	3"	2 3/8"	3 3/4"	4 7/8"	5 3/8"	3 3/4"	2 5/8"	2 9/16"	3 1/16"	4 3/4"	3 3/16"	1.20/10.3	1.32/4.5	1.50/4.5	1.80/7.0
1"	3"	2 3/8"	3 1/16"	5"	6 5/8"	3 15/16"	2 5/8"	2 9/16"	3 1/16"	7 1/4"	3 3/4"	1.55/8.9	1.75/4.5	1.50/4.5	1.25/9.3
1 1/4"	3"	2 3/8"	—	—	—	4 5/16"	—	—	3 5/16"	—	3 3/8"	—	—	—	3.15/17.5

\*3-way, U (Union Connections)



## Ordering Information



## Replacement Parts

Model	Description
9300-2044RP	Strap-on Sensor
9300-2052RP	Outdoor Sensor
iT024Q6A1	Outdoor Reset Actuator
iU024Q6A1	Setpoint Actuator

# LIMITED WARRANTY STATEMENT

Taco, Inc. will repair or replace without charge (at the company's option) any product or part which is proven defective under normal use within one (1) year from the date of start-up or one (1) year and six (6) months from date of shipment (whichever occurs first).

Taco, Inc. will repair or replace without charge (at the company's option) any iSeries Mixing Valve body that is proven defective under normal use within three (3) years from the date of start-up or three (3) years and six (6) months from date of shipment (whichever occurs first).

In order to obtain service under this warranty, it is the responsibility of the purchaser to promptly notify the local Taco stocking distributor or Taco in writing and promptly deliver the subject product or part, delivery prepaid, to the stocking distributor. For assistance on warranty returns, the purchaser may either contact the local Taco stocking distributor or Taco. If the subject product or part contains no defect as covered in this warranty, the purchaser will be billed for parts and labor charges in effect at time of factory

examination and repair.

Any Taco product or part not installed or operated in conformity with Taco instructions or which has been subject to misuse, misapplication, the addition of petroleum-based fluids or certain chemical additives to the systems, or other abuse, will not be covered by this warranty.

If in doubt as to whether a particular substance is suitable for use with a Taco product or part, or for any application restrictions, consult the applicable Taco instruction sheets or contact Taco at [401-942-8000].

Taco reserves the right to provide replacement products and parts which are substantially similar in design and functionally equivalent to the defective product or part. Taco reserves the right to make changes in details of design, construction, or arrangement of materials of its products without notification.

**TACO OFFERS THIS WARRANTY IN LIEU OF ALL OTHER EXPRESS WARRANTIES. ANY WARRANTY IMPLIED BY LAW INCLUDING**

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