

# It's In The Mix

## Using 3-way Mixing Valves

by Lawrence V. Drake

Providing the proper water temperature to a hydronic heating system, particularly a radiant floor heating system, can be accomplished in a number of ways. The use of a three-way mixing valve can be an economical choice when the circumstances are right.

Within the three-way mixing valve family there are two methods of mixing, proportional and injection. A thorough understanding of these two principles will assist in proper application of three-way mixing valves and avoid potential problems.

### PROPORTIONAL MIXING

The proportional three-way mixing valve has two inlet ports and one outlet (mixed) port. The valve mecha-

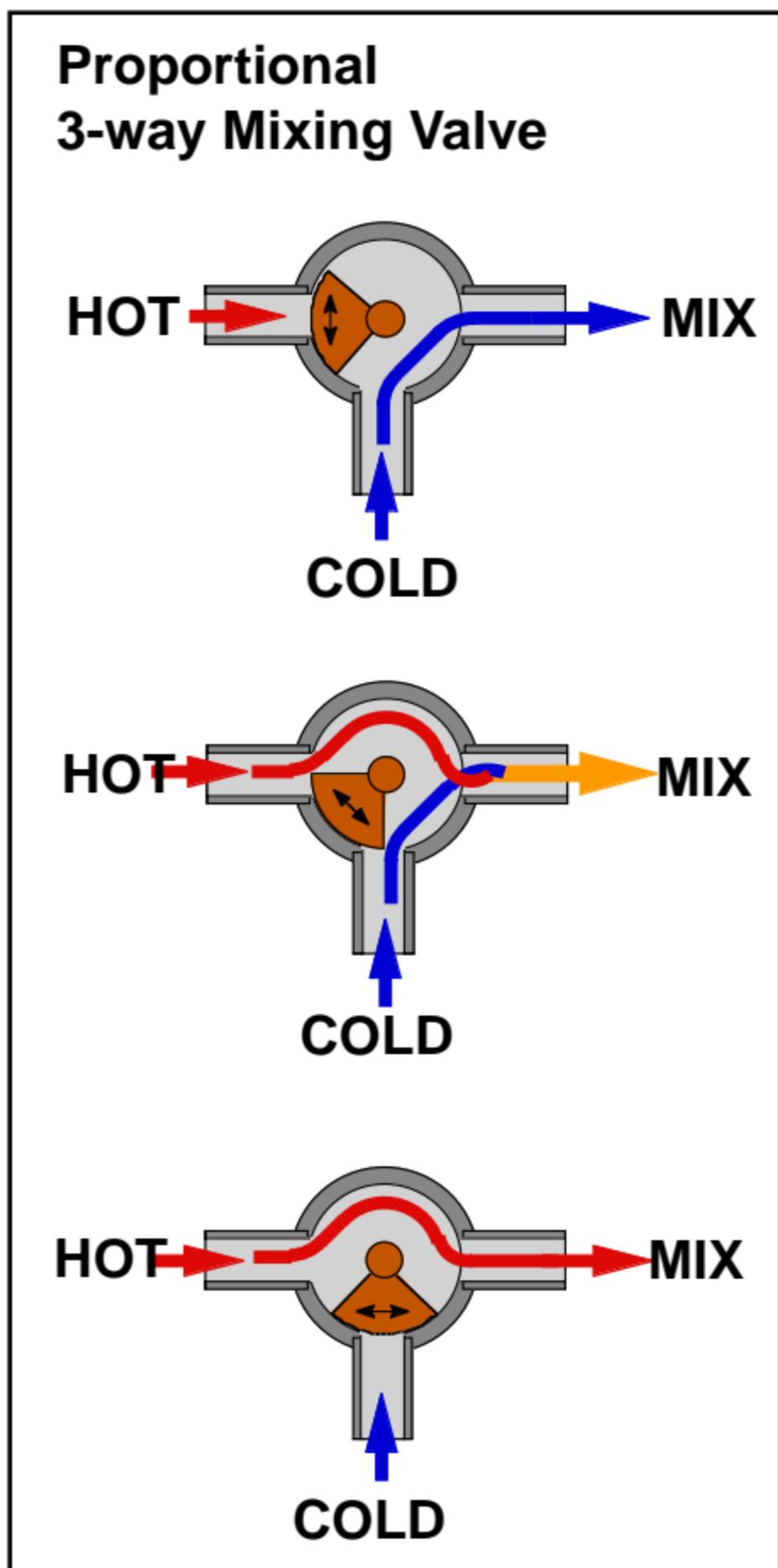
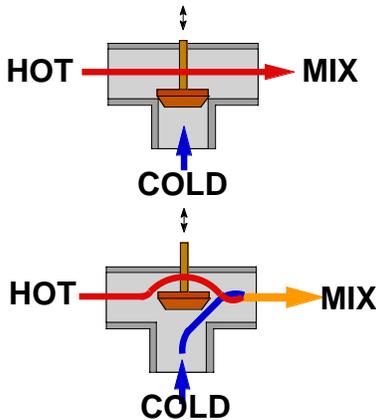


Fig. 1 - These valves have full control over the mix temperature.

## Injection (tempering) 3-way Mixing Valve



*Fig. 2 - Tempering valves only control mix temperature when cold water is sufficient.*

nism will open one inlet port while closing the other inlet port in the same proportion. This feature makes it possible to have full flow from one inlet port and no flow from the other inlet port as shown in figure 1, or any proportional combination in between. Depending on the position of the valve mechanism, a delicate blend of water flowing from both ports is available to achieve the right mix temperature.

## INJECTION MIXING

Valves using the injection method

of mixing control only one of the inlet ports. They allow free, unrestricted flow through the other inlet port to the outlet (mixed) port. Water flow in the controlled inlet port is metered into the free flowing stream of water passing through the valve. Domestic hot water tempering valves, such as shown in figure 2, often employ this technique and can, in some cases, be used successfully in radiant heating systems as well. This system relies on a significant temperature difference between the “hot” and “cold” water inlets to achieve the proper “mix” temperature.

The most common use of three-way mixing valves in hydronic systems is to either regulate the temperature delivered to the radiant surface or provide protection for the boiler from returning water that could cause flue gas condensation. Placement of the three-way valve in relation to the boiler, the load, and the pump determines which job it will do.

## MIX CONTROL

Valves can be manually set to a fixed position, but are most often controlled by a modulating device that continuously adjusts the opening and closing of the controlled port, or ports.

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A simple, adjustable thermal element that senses water temperature may be incorporated in the valve such as a tempering valve, or the valve may have a remote thermal sensor. Others have electric sensors and circuits to move a motorized valve. Sensors can simply measure the temperature of the mixed water or can be part of a more elaborate system that sets water temperature according to outdoor and indoor temperature readings.

### MIXING DOWN

To provide a lower water temperature for the radiant surface than the boiler produces, the three-way valve is placed on the outlet side of the boiler before the pump. The hot side of the boiler is plumbed to one inlet port of the three-way valve and the second inlet port is "Tee'd" into the boiler return line. In the case of a tempering valve, the boiler connects to the "hot" and the "Tee'd" boiler return connects to the "cold" port. The "mix" port is connected to the radiant distribution system (such as a radiant floor manifold). See figure 3a. In this way, the pump is always pulling water through the valve.

After the mixed water passes through the radiant surface and cools, it is plumbed back to the tee where some water is drawn into the inlet port of the valve and mixed with the hot boiler water. The remaining return water is sent back to the boiler.

The proportional mixing valve can limit the amount of hot boiler water required to mix with the cool water returning from the radiant surface to raise it to the desired temperature. The boiler water because of this proportional control cannot overheat mixed water going to the radiant surface. On the other hand, because an injection type mixing valve has a steady stream of hot water coming from the boiler, it can only limit the mixed water temperature as long as the returning water is cool

enough to do the job. This should be an important consideration when selecting an injection type valve for a job.

### MIXING UP

Cool water returning from the radiant surface can cause boiler flue gas condensation. If the boiler is not designed to handle condensation, it can be very damaging. To prevent this damage, a three-way mixing valve is placed in the return line to the boiler with the "mix" port attached to the boiler return. One inlet port, (the "hot" port on a tempering valve) is "Tee'd" in to the supply from the boiler down stream from the boiler. The other inlet port, (the "cold" port on a tempering valve) is connected to the return from the radiant surface. See figure 3b. In this configuration the pump is pumping into the valve. If water returning from the radiant surface is too cold, the valve allows hot water from the boiler to raise the water temperature before it enters the return side of the boiler, thus protecting the boiler.

### MULTIPLE MIXING

It is possible to use two or more three-way mixing valves to provide different temperatures to several zones using a single pump. As before the pump will be placed to draw water through the mixing valves but in order to do this, the pump must be placed on the return side of the distribution

system. See figure 3c.

### LIMITATIONS

By design, three-way valves vary water flow. The water flow at each inlet is not constant. That means that the flow through the boiler will vary with the demand. Low flow rates may not be compatible with low mass, rapid recovery boilers. The three-way mixing valve is also blind to return water temperature, so boiler protection may be required. Three-way injection type mixing valves, such as domestic tempering valves, cannot limit mix temperature if the return water is not cool enough.

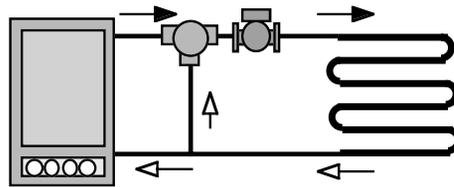
### APPLICATIONS

Given the limitations of three-way valves, there are still plenty of good applications. Tempering valves can work well when it is known that the return water temperature will be low enough to provide adequate mixing and the boiler is not sensitive to flow or cool return water temperatures. Proportional three-way mixing valves do not need cool return temperatures so they can be used as long as the boiler or hot water source

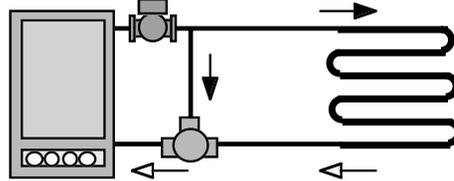
can accommodate the return water. Both systems work well for boiler protection.

Three-way mixing valves can provide a good alternative for higher priced, more sophisticated controls in many applications. ■

a. Mixing Down



b. Mixing Up



c. Multiple Mixing

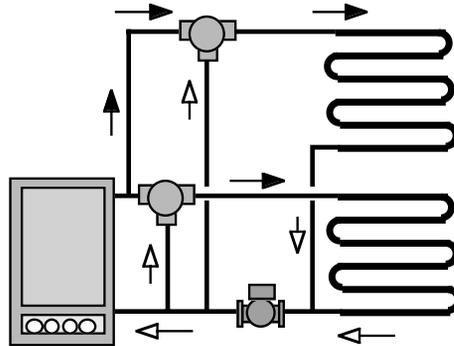


Fig. 3 - typical mixing configurations for three-way valves.