Thermostatic three-way valves... (The how's & why's)

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Radiant heating has seen significant resurgence over the last 10-15 years. The benefits of this type of heating system are numerous. I would like to discuss some of the piping details that come in to play when designing and installing these radiant heating systems. These details have become important because, when traditional baseboard systems are installed, there aren't a lot of piping issues. The reason is the design water temperatures for the heating elements (baseboard, C.I. Radiators & C.I. baseboard) are usually the same temperatures as the aquastat settings in standard cast iron boilers. But radiant systems are typically designed around lower water temperatures, usually 120°F–140°F. The standard cast iron boilers usually cannot operate down in this range without the chance of condensing their flue gases. For the radiant system to operate properly, some type of mixing device needs to be installed. The job of the mixing device is to take a portion of hot boiler water and blend it with a portion of cooler return water to send out a "mixed" supply water temperature to the radiant system. Of all the mixing devices available, probably the most common and least expensive is the three-way thermostatic mixing valve.

Three-way thermostatic mixing valves have been around for a long time. Most contractors feel comfortable when discussing or installing these valves. Nevertheless, you would be surprised the number of problem jobs I have seen where the three-way valve was installed incorrectly, causing customer complaint calls. So, let us discuss the Right and Wrong way to install these mixing valves.

If you look at figure 1, you will see the proper piping method for a three-way thermostatic mixing valve. Hot water from the boiler enters one of the ports (we'll call A) and mixes with a portion of cooler water returning from the radiant system and which enters port B. The resulting mixed water temperature flows out of port C and heads out to the radiant tubing system.

FIGURE 1

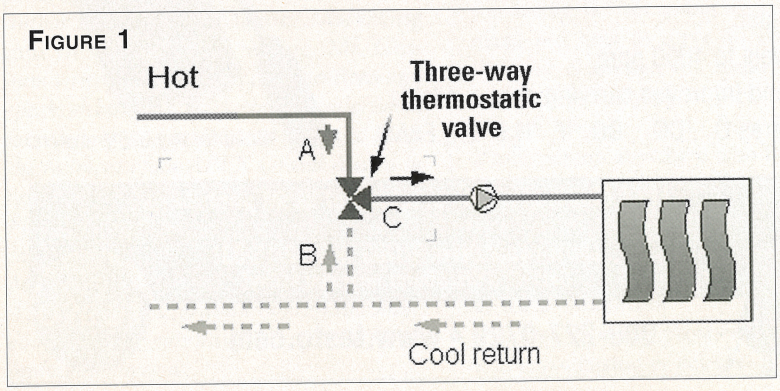
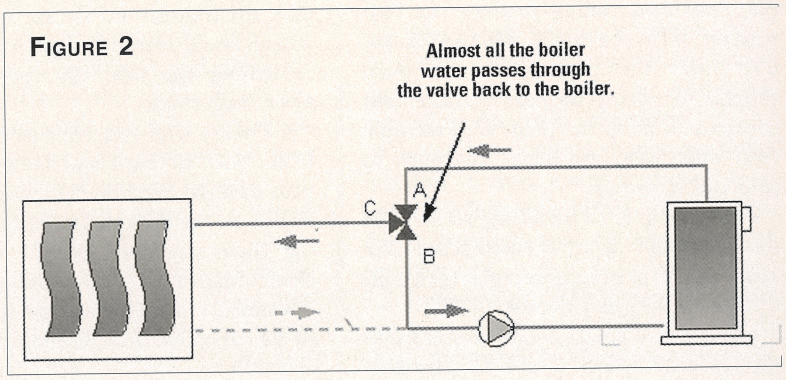


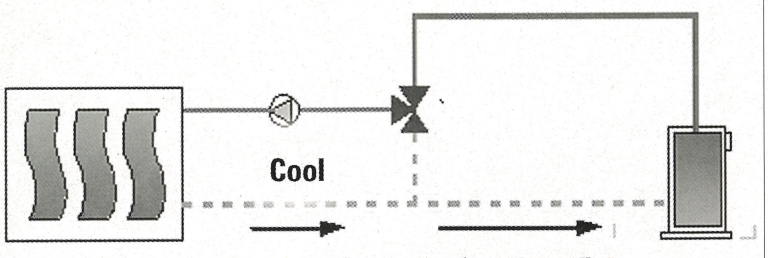
FIGURE 2



What is important to note is the location of the radiant circulator. It HAS to be located between the mixed outlet port (C) and the radiant system. By locating the circulator in this manner, the proper flow rate and mixed supply water temperature will be established for the system.

Some of the problem jobs I have seen occur when the radiant circulator ends up being installed on the return. Not that locating the circulator on the return will cause the "end of the world". It is just VERY important where on the return the circulator is installed. If the circulator is installed like the one in figure 2, the radiant system is going to experience problems. What happens in installations like this is a majority of the hot boiler water, which enters port A, passes through the internal passageway of the valve, exits through port B and returns back to the boiler. Of course, the reason this happens is because the water that leaves the discharge side, the circulator wants to get back to the suction or inlet side of the circulator. And water will always follow the path of least resistance, which happens to be the internals of the mixing valve instead of the radiant tubing. Only a small percentage of water passes through the radiant tubing system and this water temperature is hot boiler water. Of course, the flow rate is minimal, causing a very high temperature drop across the radiant circuit. The heat output from the floor is severely limited causing customer discomfort and complaints. Ideally, to correct this problem, relocate the pump on the supply as in figure 1. But if you can not relocate to the supply, at least relocate

FIGURE 3



Cool water from the radiant circuit flows directly back to the boiler, possibly causing condensation of the boiler's flue gases.

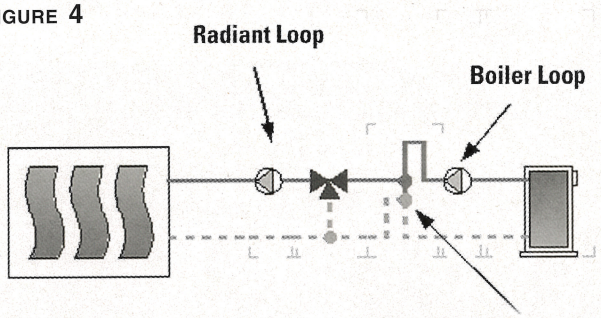
the pump so that it is located between the radiant return piping and the by-pass piping that leads to port B on the mixing valve.

Another problem that happens often with the three-way thermostatic valves, is that even when they are installed correctly, there still exists a chance of condensing the boiler's flue gases. If you look at figure 3, you can see that whatever water temperature is coming back from the radiant floor, if does not enter port B; it is circulated right back to the boiler's inlet. Depending upon the load of the system and its flow rate vs. the boiler's capacity, you could cause the flue gases to condense in the boiler and in the flue piping.

One piping method that has been used somewhat successfully is to pipe a separate boiler loop with its own circulator just around the boiler. Then, off this boiler loop, with closely spaced tees, connect the thermostatic three-way valve and its circulator (See figure 4). By using the closely spaced tees, neither circulator will have any impact on the operation of the other circulator. Also by adding this boiler loop pump, you have created a second mixing station. This mixing station can then attempt to elevate the return temperature of the water coming back from the radiant circuit. Most of the time, this will take care of any flue gas condensation issues. However, under certain conditions, even this won't protect the boiler and measures that are more aggressive need to be taken.

In the next issue, we will discuss the use and piping details of automatic three-way and four-way valves. If you have any questions please call me at FIA at 1-800-423-7187 or email me at gcarey@fiainc.com. ❑

FIGURE 4



The boiler loop pump mixes a portion of the boiler water right here with some of the cool return water, which elevates the temperature of the water entering the boiler