

# Controlling Comfort

- A Technical Essay by Richard Trethewey -

**A**s the radiant floorheating market continues to grow, there is plenty of information out there nowadays; much of it is very good. The tubing layout and sizing stuff is great. The place where I see real confusion is in the control portion of the industry. In this technical essay, I thought I would review some of the options including features, benefits downsides on all methods



First let's start with the delivery of heat by radiant means. On a mild day, you only need mild temperature water temperature. On a very cold day, you should have hotter water up to a maximum temp of 140 F (if you went over this temperature, it shouldn't have been radiant, your floor covering was too thick or you should have had a second stage heating method) On the days between the coldest and the mildest, the water temperature should change in direct relation to the outdoor temperature. Radiant with it slow response time and flywheel effect should make gentle changes. We are trying to steer an ocean tanker like a performance sports car.

One system out there does a fancy computer generated heat loss and circuit schedule that goes something like this; 6 loops for carpet at 140F, 4 loops of wood at 124F, 8 loops under tile at 118F and 3 loops in the basement concrete at 93F. They recommend a fixed temperature thermostatic three-way valve for each water temperature. NOW, when do you need these temperatures? On the coldest day of the year! (which happens about 14 hours a year) The other 99.9% of the heating season, you had too much temperature and you have to rely on the local thermostat to keep from overheating.

## Fixed temperature mixing valves

## Three way motorized mixing valves

## Four way motorized valves

Injection pumping systems (Primary loops remaining in the mechanical room)

Primary secondary pumping systems with remote mixing stations (Hot primary loop goes through the building)

Two schools - low temperature zealots and the turn it up radiant always works crowd

When we look at the three types of methods of controlling low temperature systems, we can compare them on a variety of criteria. If we look at the radiation side of the system (the tubing or radiators), they all perform identically. Each can give precise flowline temperature, either weather responsively or room responsively. It is when you look at boiler side that big differences occur. What end of the donkey do you want to look at?

**Boiler protection** The only two that protect the boiler are the four way valve and injection. The three-way has no pre-tempering effect at all. Whatever temperature is coming back from the radiation is what the boiler sees. For small load radiant jobs, this temperature is not enough to kill the boiler but as system size increases, boiler protection is more important. Viessmann four way valves have a slotted V in their moveable core, which provides a venturi effect to mix boiler water and system return water at the boiler return. No boiler side pump is needed for boiler protection with Viessmann

**Standby loss** The highest standby loss, by far, is with an injection system. By having a boiler pump rat-race boiler water through the primary loop, you have created a radiator to release heat to the basement. A four way valve does not need a boiler pump unless the boiler it is connected to is small mass, high flow restriction or flow sensitive boiler. All Viessmann boilers with the exception of the commercial Rondomat are flow insensitive.

**Cycling** The highest cycling will be with an injection system. Because of the boiler pump and high standby loss, cycles will increase. Viessmann boilers with high water content, highest levels of jacket insulation and no minimum flows will cycle a fraction of injection systems.

**Piping ease** A three way or four way valve is far easier to pipe than an injection system with its maze of pipes and pumps. On injection systems, if the pipes are too far apart from each other than ghost flow will result. Ghost flow often happens even when its piped right! Be prepared to return with check valves.

Between a three way and a four way, the four way is the easiest to pipe correctly...*The boiler supply must have a choice between going out to the system or returning to the boiler. The system return must have the same choice. The boiler supply must be opposite the system return. That is the only rule. The mixing valve and motor can be re-oriented to accommodate any side that the boiler supply enters the four way.*

**Wiring ease** – The big selling feature for injection when it was first invented was that it was cheaper than a mixing valve. Did that figure include going back once or twice to get the wiring right?

**Electrical load** – The Viessmann mixing valve motors use a 120-volt motor with low amperage and they only draw any load when they occasionally move to modulate. Injection has a primary pump, an injection pump and a system pump. Viessmann only has a system pump.

**Service** - In the middle of the night, a Viessmann three way or four way valve has a clutch that you move out of the way and manually set the mixing valve to the middle to get some heat. The Viessmann controls always have a manual override button to bring on every pump output and fire the boiler to high limit. Injection requires considerable skill to figure out how it is wired and to take action. Viessmann wins in a landslide on service.

**IMPORTANT NOTE:** When using a condensing boiler, it will only condense when the return water comes back to the boiler at 136 FOR LESS! For this reason, you should never use injection or a four-way valve on a condensing boiler. You don't want boiler protection on these heating appliances!

If you are going to use relatively un-insulated cast iron sectional boilers, then injection might be better than nothing. But you should understand the long-term ramifications of this American fad. It could never EVER be used in Europe where electric load and standby losses are considered in your efficiency rating. It would be laughed at with the same gusto as tank type water heaters that give off more standby loss than any appliance made and last about 5 years.