Unwanted Heat in a zone? Check for ghost Flows...

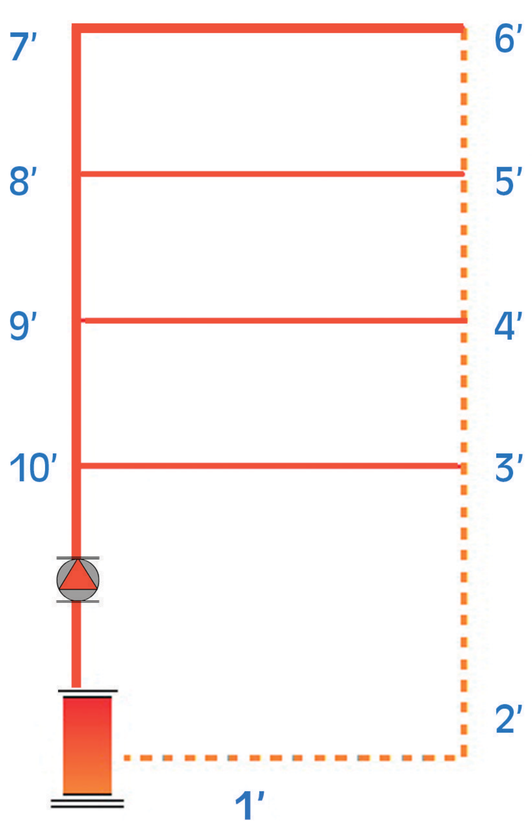
By George Carey

I am sure you have heard the expression "water takes the path of least resistance." If you have been in the heating business for any length of time, you've probably come across these expressions or possibly experienced them out in the field.

They usually show up as NO HEAT calls! The thermostat is calling, the circulator is running, but there is no heat coming out of a certain radiator or piece of baseboard. You check for air but only water comes out of the vent, so you know it can't be an air problem.

The problem is there isn't enough water flowing into the radiation. The reason for that is there isn't enough pressure differential (ΔP) across the radiation circuit. This causes the water to "short circuit" through the closer circuits or zones.

Figure 1



Look at figure #1. In this drawing, there is a boiler, a circulator and four circuits. I have applied numbers throughout the piping circuit. These numbers represent the pressure differential that our circulator can develop when it is on. In this example, our circulator can develop ten feet of pressure differential. Note that as the water moves throughout the piping, the pressure differential is lowered until it reaches the suction side of the circulator, where it equals zero. Also, note that as the water moves further away from the circulator, the pressure differential across each circuit becomes less and less. And since a difference in pressure is what causes flow to occur, you can see why the furthest circuit or zone in our example might come in as a No Heat call on a very cold day. There is a difference in pressure across the circuit which means water *is* flowing there. The problem is not enough flow rate is moving through that circuit. On a cold day, all of the Btus will "jump off" the baseboard in the first couple of feet, leaving cool water to flow through the remaining element.

Ghost flows can occur in a hydronic heating system for the exact same reason. A pressure differential exists across an open circuit, allowing water to flow where it doesn't belong. In this case, the complaint is *overheating*! Here is an example of that exact problem which I had the chance to see firsthand:

An oil company had replaced a boiler over the summer for a new customer. They didn't spend a lot of time looking at the entire piping system, but rather just the piping in the boiler room. They pulled out the old boiler, installed the new one and attached the existing piping in the same manner that it had been piped.

When the heating season arrived, the homeowners called the company to complain that several zones were overheating.

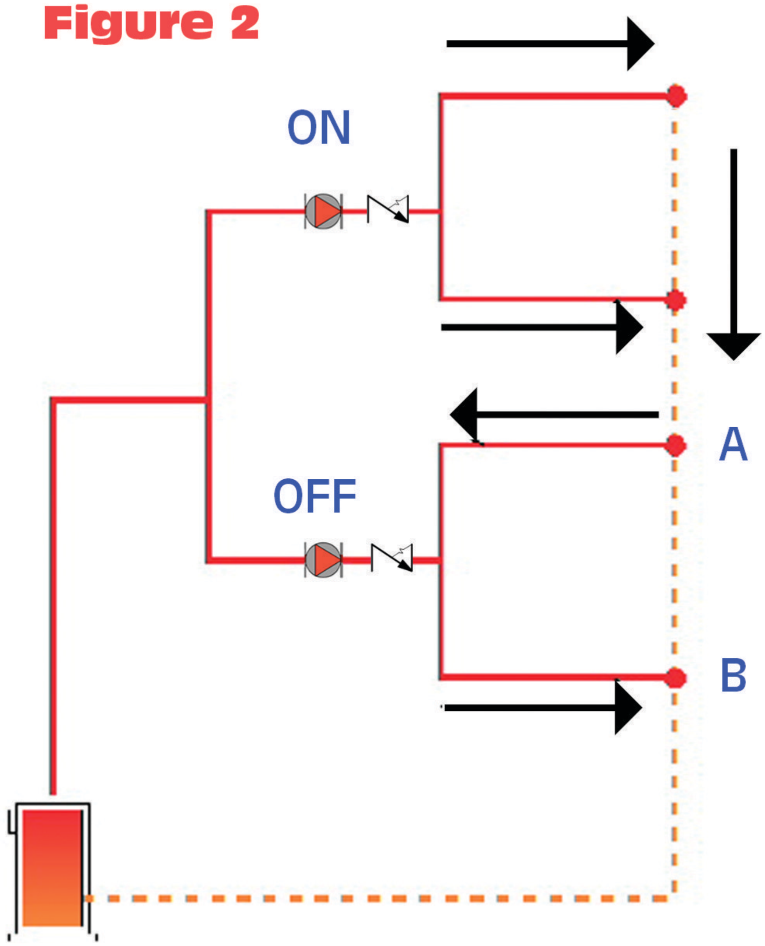
The company sent a service man over to the house. He checked to make sure the flow-control valves were working. He made sure each thermostat was wired properly to its respective relay and circulator. Everything appeared to be in good working order. Next, the technician went upstairs and checked the room temperatures compared to the thermostat settings of the zones that were overheating. He found each thermostat was set at 60°F and the rooms were measuring around 75-76°F.

At this point, the service technician called in the service manager to look at the job. After much gnashing of teeth and wailing, the homeowners admitted that *maybe* the same problem existed with the old boiler. They explained that when the new boiler was installed, they assumed they were getting a new heating system! (I have been involved with many steam systems where the homeowner assumed that the new steam boiler was going to make all of the system's ills vanish. However, this was the first hot water system I encountered where the new boiler was going to fix the existing *system problems.*) We went to the house to see if we could find out what was causing the overheating problems.

Figure 2 is a sketch of what we found when we wandered around the basement, looking for clues. The system had eight heating zones, each with its own circulator. Several of these zones split into smaller, sub-circuits. And each return from these sub-circuits connected into the common return manifold.

What was interesting about this particular system and what made it more difficult to troubleshoot was the main return manifold that picked up all the sub-circuit returns. It was located in a crawl space between the first floor ceiling and the second floor. All you could see in the boiler room was the supply manifold with all the zone pumps and flow-control valves, their individual take-offs, and the return main that came down through the ceiling and back to the boiler.

Figure 2



Looking at the sketch, can you see how when one zone is calling for heat, the water that enters the return main manifold has access to flow up the return of an off zone?

I have labeled two returns from one of the overheating zones A and B. When the water flows along the return main and reaches point A, it asks itself, "Which way do I go?" The answer depends upon the difference in pressure between points A and B. Because *there is* a difference in pressure between these two points, some water *has* to flow up the return, moving backwards through the off zone and back down to point B. This was causing the overheating to occur. The off-zones constantly had some water flowing through the baseboard even though the thermostat was satisfied.

The solution is to combine all the returns from each specific zone pump before entering the return main. But in this case, with all the piping concealed in the first floor ceiling, we decided to install small ¾" spring checks on the returns of each baseboard circuit. When we did that, the ghost flows disappeared.

Always remember that there needs to be a pressure-differential across a circuit for water to flow. If there is no pressure differential, then there is no flow! If there is a pressure differential across an off-zone, there will be flow when it is not wanted.

Any questions or comments please call me at 1-800-423-7187 or email me at gcarey@fiainc.com.