Bell & Gossett CounterPoint™

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The importance of pressure differential in a hydronic system

We've all heard the expressions, "Water takes the path of least resistance", and,"Water is lazy, it goes where it wants". And if you've been in the heating business for any length of time, you've probably experienced these expressions in the field when you go out on a "No Heat" call.

On such calls, you find that the thermostat is calling for heat, and the circulator is running, but there is no heat coming out of certain radiators or pieces of baseboard. You check for air in the system, but only water comes out of the vent so you know it cannot be an air problem. Why, then, do we keep bleeding the radiation when the real problem is that there is **not enough** water flowing into the radiation? If there isn't enough pressure differential (delta P) across the radiation circuit, the water "short circuits" through the closer circuits or zones.

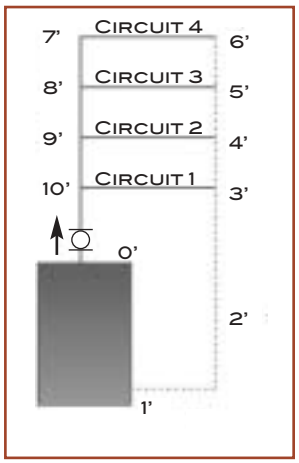

Figure 1
Pressure differentials.

In Figure 1, note the boiler, circulator and four circuits. The numbers on the piping circuit represent the pressure that the circulator can develop at each point. In this example, the circulator can develop ten feet of pressure differential. Note that as the water moves throughout the piping, the pressure is lowered until it reaches the suction side of the circulator where it equals zero. Also, note that as the water moves farther 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 farthest circuit or zone might create a "No Heat" call on a very cold day. There is a difference in pressure across the farthest circuit which means that water is flowing there. The problem is that **not enough** flow is moving through that circuit. On a cold day, all of the Btu's will "jump off" the baseboard in the first couple of feet, leaving cool water to flow through the rest of the circuit.

Why does it "short circuit"? Look at Figure 1 again and notice the pressure differential for the first zone. It has 10' of head pressure on the supply and 3' on the return side of the zone. That means there is a pressure differential of 7', and this 7' differential will cause a certain amount of flow to take place in that zone. Now look at the farthest zone which has 7' of head pressure on the supply and 6' on the return side, so only 1' of pressure differential exists across this zone.

A difference in pressure is what causes water to flow in a closed-loop system. If there is no pressure differential, the fluid simply can't move. For water to flow, there must be a difference in pressure between the inlet and outlet of a coil, a radiator, or a piece of baseboard. And – everything being equal - the greater the pressure differential, the greater the flow rate .

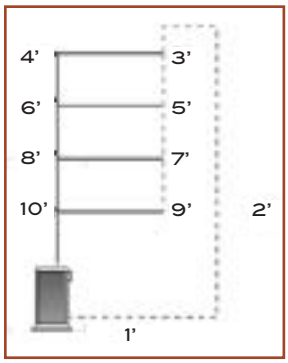

Figure 2
Reverse-return system.

So how do we solve this imbalance problem? In the design stage, it can be beneficial to install reverse-return systems (see Figure 2). With these types of systems, when the radiation is the same throughout, the reverse-return piping provides equal pressure drop throughout the entire piping system. This equal pressure drop ensures adequate flow to all the radiation units. Of course, there is a bit more piping involved, but the lack of service calls will make it well worth installing.

If you come across an existing system that is experiencing the problems described here, you should install Bell & Gossett Circuit Setter balancing valves on the return side of each circuit. By setting the Circuit Setters to the appropriate setting, the pressure drop in each circuit will be the same. With equal pressure drops in each circuit, there is no "path of least resistance", and so there will be adequate flow in each circuit.

Whenever you find yourself troubleshooting a hydronic system, consider pressure differential and the role it plays in a successful heating system. And remember, high pressure **always** goes to low pressure.

Circuit Setter® calibrated valve balances hydronic system flow rates.

If you have any hydronic questions or problems, contact your local Bell & Gossett representative. They have solutions to all of your hot water heating problems.