6 Answers to some Common heating questions

By George R. Carey, Jr.
Vice President, Fluid Industrial Associates, Inc.
gcarey@fiainc.com

During this past spring season, we have presented several seminars. Of course, a lot of questions are asked during these classes. The following is a sample of some of those questions, in no specific order.

Q: Why should I offer my customers who have hot water boilers a weather responsive control?

A: Customers who have hot water heating systems have an opportunity to reduce their fuel consumption by adding an outdoor reset control to their boiler system. When a heating system is designed and installed, it has to be sized for the specific design conditions that occur in that particular area of the country. Up here in the Northeast, outdoor design temperatures can be anywhere from 10°F to as low as -20°F, but regardless of what temperature you use to size everything, these conditions occur for only 2-3% of the total heating season. For the rest of the season, the boiler and radiation is, in effect, oversized for the building. Systems that operate only on the boiler's aquastat are subject to short cycling and noticeable temperature swings in the living environment. By installing an outdoor reset control, the water temperature leaving the boiler will change as the load on the building changes. The warmer it is outside, the lower the water temperature that will be needed for the radiation to operate. This will reduce any noticeable temperature swings and reduce boiler short cycling. The end result is a heating system that is more comfortable while consuming less fuel.

Why do the tees in a primary/secondary system need to be located so close together?

When describing primary/secondary systems, this question comes up often. Why so close and what happens if you don't install them close together. The tees need to be close together so that the operation of the primary circulator will not cause flow in the secondary circuit, and vice versa. You are trying to hydraulically isolate one circuit from the other. If the space between the tees becomes excessive, the pressure drop between the tees increases. This will cause some flow/heat to move into the secondary circuit from the primary loop, regardless of whether the secondary circuit wanted the heat or not. In effect, you have lost control of the system. You will experience overheated zones and comfort complaints.

When I am replacing an old steam boiler with a new one, why do I need to count all the radiation in the house?

Why can't I do a heat loss on the house and size my boiler based on this information? The reason the radiation load needs to be calculated—unlike a hot water installation, where water fills the entire system—is that in a steam system, air occupies all the piping and radiation above the boiler water line. Also, water is the heating medium in a hot water system. The boiler heats the water, which then travels throughout the system, Although it takes a temperature drop, it never changes state; it leaves as water and comes back as water (just a little cooler). In a steam system, we have water that is heated in the boiler to a point where it changes into its gaseous state (steam). Then the steam leaves the boiler and enters the piping system where it encounters cooler surfaces (steel pipes and cast-iron radiators). The cooler temperatures cause the steam to condense back to water.

When this happens, the energy that was required to change the water into steam is released. If your new boiler can't produce enough steam to fill ALL the radiators, then some rooms are going to remain cold. Using the heat loss method doesn't help, because the steam doesn't know anything about heat losses. All it knows is cold metal, so your job is to make sure the new boiler can overcome the "condensing action" of all the pipes and radiators.

Why can't I pipe the new steam boiler the same way as the old boiler that I'm taking out?

Older steam boilers had three important characteristics that helped them produce good dry steam. First of all, the section-width was wide, allowing the steam bubbles to rise to the water surface calmly. Once at the surface of the water, the steam chest was cavernous, allowing the water and steam to separate efficiently. Lastly, the exit hole diameter was designed to limit the steam's exit velocity to 15 FPS. This ensured that only dry steam left the boiler and entered the system piping. Because of these factors, the installers could attach the boiler to the system piping with some "interesting" methods. The problem with attempting that today is the fact that a modern steam boiler is lacking in all those areas. The section width has become narrower, causing a "frothy-like" mixture of steam and water to occur as the steam bubbles try to pass through the water. Also, the steam chamber is virtually non-existent in the new boilers. Finally, size of these exit holes is smaller and there are fewer of them. This INCREASES the steam's velocity as it leaves the boiler, which increases the chances of pulling water up out of the boiler with the steam. With modern steam boilers, it becomes very important to pipe the new boiler according to the manufacturer's installation instructions. The near-boiler piping has taken on the responsibility of producing dry steam. If you ignore the instructions, there is a good chance you will have problems.

When troubleshooting two-pipe steam systems, why is it OK to use temperature as an indicator when searching for bad radiator traps, but not for the end of main F&T traps?

Radiator traps are also called thermostatic traps, and as the name implies, temperature affects the operation of the trap. When steam arrives at the radiator, it elevates the temperature around the trap causing it to close. When the steam condenses and turns back to condensate, the temperature cools down, allowing the trap to re-open. So it stands to reason that temperature can be an indicator of a good or bad radiator trap. However, F&T traps (float and thermostatic) operate a bit differently. There IS a thermostatic element in there, but it only vents air through the trap. Any condensate that forms is drained off through a float and seat mechanism. However, the float doesn't care about temperature, only displacement, which is caused by a volume of condensate. This means, technically, you could measure the steam's temperature on the inlet side of the trap and measure almost the same temperature of condensate coming out of the trap. Therefore, temperature as an indicator can be very misleading! When troubleshooting F&T traps, a better solution is to see what is discharging from the trap. Through a combination of some piping changes and valves and nipples, you can install EVERY F&T trap with its own test station. The added cost of a few nipples and a valve is offset by the ability to troubleshoot the trap later.

Why should I install the circulator on the supply side of the boiler piping? I have always installed them on the return and they worked fine!

It is true that most small, residential circulators will work OK when they are installed on the return. It is also true that the system will operate better/more quietly/possibly more efficiently when the circulator is installed on the supply. What's important is to know what happens when a circulator turns on and how it affects the system's static pressures. When you locate a circulator on the return, it is "pumping" towards the system's expansion tank. And the expansion tank's connection to the system is called the "point of no pressure change." Therefore, the circulator's pressure differential cannot change the pressure at the location of the tank.

Of course, the circulator still has to create a pressure differential across itself, but since the discharge pressure can't change, the pressure on the suction side drops. With small residential circulators, the pressure differential is low, so the static pressure is lowered slightly.

But with larger circulators, the differential can cause the system's pressure to drop below atmospheric pressure (vacuum) and create all kinds of air/noise/gurgling problems. Why not locate the circulator in a place in the system where it is working for you, instead of against you?

If you have any questions or comments, e-mail me at gcarey@fiainc.com or call me at FIA. 1-800-423-7187 or follow me on Twitter at @Ask_Gcarey