BOILER FACTS

TOOLS AND TECHNIQUES FOR TECHNICIANS

by George Carey
gcarey@fiainc.com

Indirect water heaters and steam boilers

Over the course of the heating season, I had a chance to see a lot of problem jobs. I have seen problems with everything from one-pipe steam systems to large forced hot water commercial systems to domestic hot water systems. The common theme with all these problem jobs is that they have troubling financial consequences for both the customer and the Oilheating company.

Indirect water heaters, piped off a steam boiler, can be a source of problems if not installed properly. These water heaters have become very popular over the last 20 years or so, even though the principle has been around since the 1930s.

Installing an indirect heater off a steam boiler is an effective way of providing your customer with more domestic hot water capacity. There is no flue pipe attached to the heater, so there are no BTUs going up the chimney. And the tanks today are well insulated, which eliminates the high stand-by losses that can occur when heat passes from the stored hot water to the surrounding air temperature. The high combustion efficiency of modern boilers gives you an efficient use of oil to produce hot water. But there are some pitfalls to avoid. The first one concerns the circulator.

Where to locate the pump?

It is very important that the circulator be installed on the supply, pumping towards the coil in the indirect water heater. That's because there is a place in a closed hydronic system known as the "point of no pressure change." It is the one place in the system where the circulator's pressure differential can't change the system's static pressure. This place is where the expansion tank is connected to the system piping.

In a "normal" system, you would have the expansion tank, either a diaphragm or plain steel tank, installed on the supply side of the boiler. But in a steam boiler there is no expansion tank. Or is there?

In fact, the boiler becomes the "point of no pressure change" because the steam chamber above the water line is filled with a gas (air or steam), the same as an expansion tank. When a circulator comes on, it either adds or subtracts its pressure differential to the system pressure, based on its location relative to this "point of no pressure change." If the circulator is installed so that it is pumping toward the boiler on the return, the pressure on its suction side will drop by the amount of pressure differential it can develop.

Pressure and Water Temperature

What does all of this mean? You have to remember there is a direct relationship between the pressure and the temperature of the water. If the water is too hot, relative to the pressure it is under, it will flash into steam. Keep in mind, we are talking about circulating condensate from a steam boiler. There is no pressure-reducing valve to fill and pressurize the system. The only pressure available is the static weight of the water in the boiler. A column of water 28" high is equal to 1 pound of pressure per square inch (psi). Based on standard residential boilers, the normal water line is probably 2'-3' high, above the circulator which corresponds to about 1-1½ psig (pounds per square inch gauge).

The other part of the equation is the temperature of the water. In a residential steam system, it is not uncommon to see the boiler operating at 1-2 psig. If you were to look at a steam table, you'll notice that at 2 psig, the water temperature is 219°F. This means that as long as the circulating condensate is at least 2 psig, it will remain as water.

But if the pressure drops, and it will every time a circulator on the return comes on, some of that hot condensate will flash into steam. When water flashes into steam, it expands in volume 1,700 times. Likewise, when steam condenses back into water, it shrinks in volume 1,700 times, creating a void. Unfortunately, the surrounding water comes crashing back together, trying to fill this void. The result is a loud, coil-wrecking water hammer—the type of noise that wakes people up in the middle of the night—the type of noise that creates numerous service callbacks. The type of noise that drives

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service managers crazy!

The way to correct this customer-service nightmare is to make sure the circulator is located so it is pumping toward the coil in the tank, away from the boiler. Installed this way, every time the circulator turns on, its pressure differential is added to the static pressure, thus increasing the pressure on the condensate and making for quiet operation.

The Job of the Aquastat...

Another problem source when dealing with indirect water heaters and steam boilers can be the aquastat—specifically, its location. Sometimes we get a complaint that a circulator is not working properly because the indirect heater runs out of hot water or does not recover fast enough. After spending some time on the job, we find that the location of the supply and return connections are allowing the pumped flow to short circuit through the boiler. During the heating season, when the boiler is constantly cycling to provide heat, this problem isn't detected. But come the "shoulder months" of the heating season, or especially in the summer, the problem jumps right out at you.

When there is call for domestic hot water and the boiler isn't making steam, there is usually an aquastat in the boiler that allows the burner to fire up to a set temperature (usually 180°-190°F). This is to prevent the boiler from heating the water to the point where it starts making steam. This is important because you don't want steam sent out to the radiation in the summer.

The location of the aquastat is critical. If the supply and return connections are located on the boiler so there is a straight path from the back of the boiler to the front, there is a good chance of short-circuiting. The water tends to take the path of least resistance, and if allowed to, it will. The aquastat's job is to fire the burner whenever the water temperature drops to a pre-determined level. If the aquastat is located out of the path of the pumped flow, it won't "see" the temperature drop that occurs as the condensate circulates through the indirect coil. As a result, the water circulating through the indirect coil becomes too cold to transfer heat and the domestic hot water becomes domestic COLD water. The best way to avoid this happening is to make sure the condensate has good cross-sectional flow through the boiler. That way, the aquastat has a chance of sensing the temperature drop of the condensate coming back from the indirect coil, allowing the boiler to keep up with the domestic demand.

If you have any questions or comments call me at FIA at 1-800-423-7187 or email me at gcarey@fiainc.com