Two-Pipe Vapor Vacuum Steam System Oddities

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I received a phone call from the owner of an oil company in the Boston area whose customer had a steam boiler that failed and needed to be replaced. His salesman went out to review the system and come up with a quote.

He came back to the office with a question. The system was a two-pipe steam system, but there were *no* traps on the outlet of any radiator. The salesperson had never seen a system like that and was looking for advice before he quoted the customer on a new boiler. The owner called me to find out what kind of trouble they could be getting themselves into if they proceeded. I talked with him about how two-pipe steam systems with dry returns have to operate.

A two-pipe steam system with dry returns *has* to have traps on the outlet side of every radiator. It has to! Why? First, we need a good understanding of what a dry return is. When they say *dry*, it doesn't mean it is *always dry*. It will, in fact, get wet any time condensate is flowing from the radiator and back to the boiler room.

The dry part refers to if the piping is above or below the water line of the boiler when the steam system is off. If it is above, then it is filled with air whenever the system is off—that constitutes a *dry return*. Dry returns are also connected to each other above the boiler's water line. As the individual radiator returns work their way back to the boiler room, they connect into a common return line that brings back all the radiation's condensate back to the boiler room. Once in the room, a main vent is normally located near the end of the return before it drops down towards the floor, where it then becomes known as a *wet return*. Why? This section of piping is *always* below the boiler's water line.

Back to the reason why two-pipe systems with dry returns *have* to have traps located on the outlet of each radiator—if they didn't, the steam would travel past the radiator and get into the dry return piping. That's where the problems begin! When a steam system is working properly, there is a difference in pressure between the supply and the return side of the system. If that difference "goes away," the steam will stop dead in its tracks. Without pressure differential, there is no motive force, no reason to flow out into the system.

When the guys called me and told me they were working on a two-pipe steam system that has dry returns but *no* traps—I told them to go back and really check! When they got back, the answer was the same—*there were* no *steam traps connected to the radiators, only union elbows or little P-trap elbows!*

Congratulations, I told them, *you are now working on a* ***very*** *old vapor or vapor/vacuum steam system*. Back in the day, before thermostatic radiator traps were developed, heating engineers were forced to experiment with various methods to stop steam from passing through a radiator into the return portion of the system. They knew that if the steam passed into the return, the system would not work effectively. These union-elbows actually had a dip-tube like structure on the inside of the radiator that "dipped" down below the water seal that sits at the bottom of every radiator. These dip-tubes also had a very small hole located above the level of the water seal to allow air to vent out of the radiator. A small amount of steam would pass through the hole but would quickly condense as it left the radiator.

Most of the questions I receive are centered on the failure of the existing boiler plant, which now needs to be replaced. In addition to the normal concerns of replacing a steam boiler, because of the "weird" steam traps, contractors ask if there is anything else they should be concerned with. The answer can be tricky. One option is to leave everything as-is and "kind of hope for the best." If the new boiler doesn't need a feed tank to support the lack of water in the replacement boiler, and the dry returns are in good shape

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and pitched in the right direction, the home can probably survive the replacement.

I would suggest changing from the pressuretrol that comes with the new boiler to a vapor-stat. These systems by their very name—vapor or vapor/vacuum—indicate they were designed to run at very low pressures, ounces in fact. A vapor-stat, though more expensive, is much more accurate in controlling the pressure in the system to ounces. Because the vapor-stat will operate the system in ounces of pressure instead of pounds, it becomes critical to *use* the largest capacity main vents installed at the end of the dry return(s). The new boilers are physically smaller, holding less water. They are more apt to build pressure quickly, especially if the air in the system can't get out quickly and effortlessly. By replacing the old vent with a large capacity vent, you can prevent the new boiler from short-cycling.

If the replacement boiler does require a feed tank, then the stakes are raised. I would strongly suggest replacing all of the old dip-tube style traps with thermostatic radiator traps. With a vented feed tank that's open to the atmosphere, you have to ensure that the steam can't get past the outlet of each radiator or it will eventually blow out the vent pipe, f lling the boiler room with steam. This obviously makes the job more expensive, but if you try to use a feed tank with the old style dip-tube traps, you are creating more trouble for yourself! You will also have to install an F&T trap at the end of the steam main to keep the steam in the supply-side only of the system. The vapor-stat isn't quite as important if new radiator traps and a feed tank are installed.

The important thing to remember is that when you come across a two-pipe steam system and it has dry returns, there has to be some type of "trapping" device on the outlet of each radiator, and it has been there from the very beginning.

If you have any comments or questions, please call me at 1-800-423-7187, Tweet me at *@Ask_GCarey* or E-mail me at *gcarey@f ainc.com*. **ICM**