New steam boilers— old steam systems

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A call came into the office just the other day from a frustrated oil dealer who felt he was on the verge of losing a customer. It seems the customer, who has an old two-pipe vapor-vacuum steam system, recently had his boiler replaced. Unfortunately, ever since then, the account has become a call back nightmare! The customer has been calling every few days complaining about severe water hammering noises. When the service technician arrives at the job, he finds the boiler flooded and ends up draining gallons of water out of the boiler. Consequently, we set up an appointment to visit the job and wrestle this heating riddle.

The house was a large old Victorian-style from the early 1920s. The steam system still had some old remnants from its former greatness! Indirect radiators hung in the basement inside old sheet metal ductwork. These "radiators" looked like mini cast-iron sectional boilers. Their job was to heat the fresh air that was carried throughout various rooms in the house by the ductwork. Years ago, when these systems were being installed, people thought the air in the house was contaminated by their heating system.

To overcome this issue, the heating engineers of the time decided to ventilate *and* heat the house with a constant supply of fresh air. This, of course, increased the cost of operating the system, so it was usually found only in the homes of the wealthy. Because these "radiators" were heating the air from outside, the sizing was different from standard direct radiators (radiators you normally see in a house). I was curious how they came up with the sizing information needed to select the new boiler. The service technician explained they had an old *American Radiator Company* catalog back at the office that listed these particular indirect radiators. They were able to get a look inside the sheet metal cabinets and take down the dimensions of the indirect radiators. They totaled the square foot ratings of these indirect radiators, and combined with the standard radiators, came up with the size of the replacement boiler.

This system also had an old cast-iron vent trap located at the end of the dry return. This vent would have been the only one used for the entire system, which, by the way, is a common characteristic of vapor/vacuum systems. However, over the years the system had been modified, because the piping from this vent drained into a condensate pump and receiver.

Originally, the vent would have worked alongside a boiler return trap. The return trap's job was to help the condensate, which was draining back from the system, to get back into the boiler while it was under pressure. This device was needed because of the effect steam traps had on the returning condensate. In addition to allowing air to vent and condensate to drain from the radiator, the trap also prevented steam from passing into the returns. This was a good thing for maintaining steam distribution throughout the system

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but bad for the condensate trying to return to the boiler!

Now the only force the condensate had to return back into the boiler was by "stacking" up in the return line. Unfortunately, the condensate needs 30" of vertical height for every pound of pressure in the boiler. By the way, this height is measured starting at the boiler's water line. Most basements didn't have this clearance and so the boiler return trap came to be. At some point, it must have stopped working on this system and someone replaced it with the existing condensate pump. And the condensate pump was the cause of the current problems in this steam system.

When the old boiler was in operation, due to its physical size, it contained a large amount of water. This was very beneficial to the system's operation. When the thermostat called for heat, the burner turned on and the boiler started to make steam. This caused the water level to go down in the boiler because it was out in the system as steam.

Once out in the system, the steam would eventually condense, giving up its latent heat and turn back to condensate (water). The condensate would then drain back to the condensate pump's receiver, raise the float switch and turn the pump on. The condensate went back into the boiler and started the cycle all over again. The boiler never flooded though; because it held so much water, the level never dropped into the automatic feeder's range. You could say a balance existed between the boiler's water content and the system's time lag. However, the new, properly sized boiler contained less water. In fact a lot less water. And this made all the difference in how the system operated. Now as the water left the boiler as steam, it still took the same amount of time to come back to the receiver as with the old boiler.

Remember, although the boiler is new, you are still attaching it to a *very* old piping system. And with less water to work with, the water level quickly approached the automatic feeder's range. Of course, the feeder did the only thing it could do—add gallons of water to the system. This allowed the burner to continue making steam, but when the system finally shut down, all the condensate worked its way back to the condensate pump. Once there, the float switch activated the pump and all that condensate was shoved back into the boiler. Whether it needed it or not!

That was the problem—the condensate pump could not "talk" to the boiler. It had no idea what the boiler's water line was and whether it needed water or not. But with the old boiler and all its water content, this was never an issue. Although the old boiler had an automatic feeder, in addition to the condensate pump, the feeder was never active.

During a call for heat, the boiler never lost enough water to cause the feeder to operate. But by simply replacing the old boiler with the new, "lower water content" boiler, the automatic feeder became very active. In fact, it fed water into the boiler on almost every heating cycle. Of course, after a few cycles, the water line was so high in the boiler that the steam carried this additional water with it into the piping system. That's when the "anvil chorus" started to entertain the homeowners. Unfortunately, after only a few verses, they were not entertained and called the oil company to make it stop!

The solution to this problem turned out to be a boiler feed tank. This type of tank is much bigger than a standard condensate tank because its job is to act like a reservoir for the new boiler. It holds the water that originally was found in the old boiler.

The other benefit to this style tank is the pump that is located on the receiver is controlled by a pump controller located on the boiler, not a float switch in the receiver. And the pump controller will only tell the pump to come on when the boiler actually *needs* water and then shut it off when its satisfied. All the condensate that is out in the system gravity drains back to the "reservoir" and waits until the pump controller turns the pump on. Once they made the change, the new boiler stopped flooding, the water hammering noises were eliminated and the customer was very satisfied.

One thing I always found helpful when asked to troubleshoot any heating system is to remember to look at the whole SYSTEM, not just one or two of the components. When asked to solve a problem always look at the whole job. Don't just concentrate in the area where the banging seems to be coming from or the room that isn't heating, but rather check out the whole system. You'll be surprised at what you find.

If you have, any questions or comments feel free to e-mail me at gcarey@fiainc.com or call me at FIA Inc. 1-800-423-7187.