by George Carey

Understanding what you are looking at…

When different technologies collide!

Recently, I found myself standing in the basement of a 50-unit apartment building with a frustrated service technician. His company had recently taken over this particular account and the heating system was driving him crazy! The main heating circulator was noisy, so he asked me to meet him at the job.

The oil-fired boiler had 50 zone valves, one in each apartment. There was one main circulator located on the return and it was pumping into the bottom of the boiler.

On the supply header, right off the vertical riser from the boiler, an air scoop was installed. This particular scoop had two openings on the top. One was piped to an older-style steel compression tank; the other had an automatic air vent. The relief valve was piped to the floor and some additional piping was attached to the bottom of the valve and piped over to a floor drain. The pressure-reducing valve was piped on the return into the back of the boiler. There were numerous problems with this system, a noisy pump being one of them.

One of the more interesting things I noticed was the three old pressure-reducing valves that were sitting atop the boiler. The maintenance man told me the valves had been replaced within the past two heating seasons. Considering the piping arrangement on the relief valve, it was clear the valves had been adding so much water over a short time span that the strainers had plugged solid with sediment and mineral build-up.

I asked if the previous oil company was aware that four PRVs had been installed over two heating seasons. He said one their technicians commented that "they don't make valves like they used to."

Imagine how much fresh water, which contains a lot of oxygen, had been added to the cast-iron boiler since it had been installed. It is troubling to think that this problem could have been solved by simply relocating the circulator to its proper location. The circulator was located on the return, pumping towards the boiler and the compression tank. The place where the tank connects to the system (in this system, it was the top of the air scoop) is known as the "point of no pressure change." The hydronics industry has known about this for over 40 years. Because of its location in the system, when the circulator turned on, the pressure differential it developed could not change the pressure at the tank. So when a circulator is located on the return, pumping toward the compression tank, the pressure at the discharge side of the circulator can't increase when it turns on. Instead, the pressure on the suction side drops by the circulator's pressure differential.

On this particular job, because of the circulator's capacity, whenever it turned on, the automatic float vents at the high points in the system pulled air into the system. Naturally, this abundance of air created no heat calls, waterfall noises in the apartments and numerous service calls to bleed the air from the radiation.

Instead of addressing the real cause of the problem, the circulator's location, one of the previous service technicians had increased the setting of PRV to offset the drop in pressure caused by the circulator. Therefore, when the circulator turned on and the pressure dropped—because the system was over-pressurized—there was still positive pressure at the high points of the system. This meant the air vents were no longer pulling air back into the system.

In raising the fill pressure, the technician came very close to the setting of the relief valve. This explains why the valve was changed from 30 psig to 50 psig. (Of course, he did this on his own!!!) The other part of his problem had to do with the air in the system.

When water is heated in a boiler, air comes out of solution in the form of bubbles. These bubbles have to be dealt with before they make their way out into the piping system. Depending upon whether the system has a steel compression tank or a diaphragm tank, the air is either vented out of the system through automatic vents or directed up to the steel tank. This system had a steel tank that was suspended from the ceiling above the boiler. This is known as an "air control" system. With such a system, all of the air should be directed up towards the compression tank. There should be NO automatic float vents. Any free air in the system should be separated from the system water by an air separator and sent up to the steel tank. The air in this tank acts like a spring; it absorbs the expanding water as it is heated by compressing the air in the tank. As the system cools, the air expands as the water molecules contract, maintaining a minimum pressure on the system. It is very important that a certain amount of air always be present in the tank to keep the system within its operating range.

In this system, to make matters worse, the air scoop had an automatic air vent located in the other opening. Of course, the job of a float vent is to vent any air separated by the scoop out to the atmosphere!

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This was part of the reason for the relief valve discharging water and the pressure-reducing valve adding water all the time. The air in the tank would go back into solution as the system water cooled, and it would migrate down into the boiler. On the next cycle, as the boiler heated the water, the air would come out of solution. As this air entered the air scoop, a portion of it would be vented out of the system through the float vent. This caused the system pressure to drop. The PRV would then open and add more water to the system to maintain its desired pressure setting. Of course, the water added would enter the steel compression tank.

After a few cycles, there wouldn't be enough air in the tank to absorb the expanding water, and the pressure would reach the relief valve setting, dumping gallons of water down the floor drain. Naturally, as the system cooled the pressure dropped. The PRV would sense the drop in pressure and bring in more water to replace what had been discharged. And what was in this fresh make-up water? More air.

This system had a steel tank that was suspended from the ceiling above the boiler. This is known as an 'air control' system.

There is a reason why circulators that are installed on the return in residential systems work. But if you don't know why and you follow the same procedure in commercial systems, you'll end up with a problem. Likewise, if the system has one of those older steel tanks, any air liberated from the boiler MUST be controlled and directed to the tank.

The service technician that brought me to the job eliminated all the automatic float vents, relocated the circulator to the supply (pumping away from the steel tank) and replaced the existing relief valve for the proper valve and everything worked better!

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