

Ray Wohlfarth

# More power

*What can you do to affect the performance of your heating systems?*

"Star Trek" has always been one of my favorite TV series and collection of movies. I like when Captain Kirk pleads with the chief engineer Scotty for more power. While we may not have to jettison and explode our warp core to get more power, there could be things we do that affect the performance of our heating systems.

I am reminded of a call I received during a bitter cold snap. When I answered the telephone, I was told, "Your boilers aren't working. There is something wrong with them."

The person on the other end of the telephone call was the director of maintenance for a nursing home where we sold three boilers about four years before. He informed me that he had even raised the boiler temperature setting from 180° F to 200° but the perimeter rooms in the building were cold. He also told me they were going to have to evacuate the facility if we couldn't come up with something quickly. My service technician was close and I dispatched him to the site.

If the system is not heating with wide open valves, perhaps it is time to try closing them.

Photo credit: Jon Wohlfarth

The technician called and verified the boilers were indeed at 200° and the outer perimeter of the building was cold and the seniors were freezing. The distribution system used a main air-handling unit that sent 60° air to the building. It had hydronic reheat coils to raise the temperature in the rooms, if needed.

My technician said the owner had opened all the balancing valves for the reheat coils in an attempt to get more heat, without success. My technician was at a loss about what to do. Upon questioning, my technician informed me the heating loop ΔT or temperature drop was at 3°.

He asked if the system could be undersized and I assured him it was not. I explained that if it was undersized, the water temperature would not be at 200° and the ΔT would not be so close. Most systems are designed for a 20° ΔT. The low temperature drop made me realize the piping was not surrendering its heat to the building. It must be something in the distribution end.

When he asked what to do, I was stumped and suggested he try closing the balancing valves on the reheat coil until it gets a 20° drop across the coil. Both he and the director of maintenance were skeptical. He called back in a couple minutes and said the discharge and room temperatures had miraculously risen. They changed all the coil balance valves for the same temperature drop and the building heated to the setting of the thermostats. They reduced the boiler temperature back to the proper setting of 180°.

One of the things I have learned about this industry is that no matter how much you think you know, things can still surprise and humble you; that is what I love about it. I did some research on the nursing home situation and found it is not a rare

The fin-tube radiation enclosure in an apartment had a manual damper that was almost closed on top. Once the damper was opened wide, the heat convection was felt immediately.

**CHART 1: Steel pipe**

| Pipe size | Maximum flow (gpm) | Btuh |
|---|---|---|
| 1/2 in. | 2 | 15,000 |
| 3/4 in. | 4 | 40,000 |
| 1 in. | 8 | 80,000 |
| 1 1/4 in. | 16 | 140,000 |
| 1 1/2 in. | 25 | 220,000 |
| 2 in. | 50 | 450,000 |
| 2 1/2 in. | 80 | 850,000 |
| 3 in. | 140 | 1,300,000 |
| 4 in. | 300 | 3,000,000 |
| 6 in. | 850 | 8,500,000 |
| 8 in. | 1,800 | 18,000,000 |
| 10 in. | 3,200 | 32,000,000 |
| 12 in. | 5,000 | 50,000,000 |

**CHART 2: Copper tubing**

| Tube size | Maximum flow (gpm) | Btuh |
|---|---|---|
| 1/2 in. | 1 1/2 | 15,000 |
| 3/4 in. | 4 | 40,000 |
| 1 in. | 8 | 80,000 |
| 1 1/4 in. | 14 | 140,000 |
| 1 1/2 in. | 22 | 220,000 |
| 2 in. | 45 | 450,000 |
| 2 1/2 in. | 85 | 850,000 |
| 3 in. | 130 | 1,300,000 |

**CHART 3: PEX tubing**

| Tube size | Maximum flow (gpm) | Btuh |
|---|---|---|
| 3/8 in. | 1.2 | 12,000 |
| 1/2 in. | 2 | 20,000 |
| 5/8 in. | 4 | 40,000 |
| 3/4 in. | 6 | 60,000 |
| 1 in. | 9.5 | 95,000 |

phenomenon. If the velocity of the water through the pipe or coil is excessive, it will not surrender its heat, resulting in comfort complaints. It does not make sense but I have seen it happen.

## Open zone valves

On a similar project, we were called to an apartment building with fin-tube radiation where residents in several suites were complaining of inadequate heating. The system had an enormous circulating pump that was pumping the hot water to the apartments. The piping system had about 10 zone valves on the returns from the apartments.

When we arrived, the system sounded like a cat howling. Several of the zone valves were closed. When I manually opened the zone valves, the howling went away and the apartments that did not have heat were suddenly heating. We also noticed the fin-tube radiation enclosure had a manual damper that was almost closed on top.

I opened all the dampers wide and felt the heat convection immediately. I also instructed the tenants that couches and chairs in front of the radiation would impede the heat to circulate and should be moved. They refused, saying the furniture would not work anywhere but where they had placed it.

The last building had a combination boiler with an internal copper coil that was used for the domestic hot water for the facility. The boiler was warm but would not heat the domestic water loop. The domestic water side had primary-secondary piping. We partially closed the globe valve on the domestic water coil until the temperature increased. Once the temperature rose, the loop started heating. The client was happy and so were the people in the shower.

If the system is not heating with wide open valves, perhaps it is time to try closing them. Check the temperature drop across the loop. Most systems were designed for a 20° drop. If it is less than that, the system may not be giving up its heat. This domestic water boiler was designed for a 100° rise.

The above charts show some rules of thumb that you can use for verifying the size on hydronic systems for steel pipe (Chart 1), copper tubing (Chart 2) and PEX tubing (Chart 3) based on a 20° ΔT.

*Ray Wohlfarth is the author of "Lessons Learned in a Boiler Room: A common-sense approach to servicing and installing commercial boilers." You can purchase a copy at www.aecstore.com under the Plumbing category. In his spare time, he is president of Fire & Ice in Pittsburgh. Ray writes a monthly newsletter on commercial boilers. He can be reached at 412/343-4110 or ray@fireiceheat.com.* **PM**