FROM THE FIELD

Matching new technology to old infrastructure

BY **DAN FOLEY** CONTRIBUTING WRITER

When I first got into the trade almost 30 years ago, the equipment I installed and serviced was pretty straightforward. Truck stock was minimal and uniform across multiple lines. Most controls were simple electro-mechanical controls. For boilers, I would stock a 007 pump, a few thermocouples and power piles, a standing pilot gas valve, a L4184 aqua-stat limit-relay and a few pilot burners. With those few parts I could service maybe 80 percent of the boilers out there.

While I certainly appreciated the simplicity of yesterday, I would not trade it for the high-tech products available today. The modulating, condensing boilers we install today are far superior, safer and more efficient then the products available a generation ago. They have digital displays that show operating parameters, fault codes and lockout errors. Some have Wi-Fi technology that allows for remote monitoring. I am a firm believer in the high efficiency we currently install.

Old infrastructure

These new products do not operate in a vacuum. They are connected to old systems in old houses. They are also connected to old utilities. I certainly never gave that much thought; that is, until things stopped working.

I have a client with an 1890s vintage rowhouse in Georgetown, one of the oldest neighborhoods in Washington, D.C. The electric service there is among the oldest in the Pepco power grid. I did not consider this when we installed a new air conditioning system several years ago.

I specified and installed a new air conditioning system, which included an ECM variable-speed blower motor in the air handler. Everything worked fine until we had a typical July heat wave and the temperature crept over 100°F. Under peak load, the utility could not keep up with demand and voltage dropped in the older parts of the grid, including my client's neighborhood.

My client called me to let me know that the new system we had just installed was not working. This was a high-profile client, so I immediately responded personally. I arrived to find the outdoor unit running, the evaporator coil a block of ice and the indoor blower not operational. After pulling the disconnect to the outdoor unit, I went back in to determine why the indoor blower was off, while letting the coil defrost.

I had power to the air handler, and the contactor in the condenser had pulled in, so I knew the transformer and thermostat were OK. I put a jumper between R and G on the terminal board, but nothing—no blower. I put my cheater cord on the ECM motor, which bypasses the low voltage control electronics and provides continuous fan. Still nothing. I then broke out my digital multi-meter and measured voltage between L1 and L2 at the air handler. The voltage fluctuated between 178 and 185 volts. Now I was onto something. This voltage was too low for the electronic motor to operate.

It could be a bad service switch or a bad breaker. Both of these checked out. I went to the main electric panel and checked voltage on the main bus bars. Again, around 180 volts coming in from the street. This was a Pepco issue. Another clue was that a ductless mini-split system in the office also failed to operate due to low voltage.

I informed the client that he needed to call the power company; this was not an equipment problem. This went over like a lead balloon. I tried calling Pepco on his behalf, but they had no interest in talking to me. Besides, what were they going to do? Rip up the streets of Georgetown that night and install new feeder cable? Of course not!

My client then not-so-gently reminded me that he paid close to $20,000 for this new system and asked me what I was going to do about it. He didn't want to hear about manufacturer specs, voltage droop and utility issues. His lights worked. Another, older system in his house worked. This was my problem, not his.

Luckily for me, the weather moderated, electricity demand dropped, and voltage increased to minimum spec. I learned that when voltage drops below a certain threshold—around 190 volts—ECM blower motors cease to operate. They don't slow down. They just don't run at all. And there is no way around this.

My low-tech solution: I removed the ECM motor and replaced it with a standard one-half horsepower PSC motor. I wired it though a 90-340 relay controlled by G from the thermostat. Now when Pepco can't keep voltage within specs, the AC system continues to run. Yes, the blower motor draws higher amperage and runs hot when voltage drops, but it runs. It has been like this for three years with no complaints. Sometimes the fastest resolution to a problem is to find a creative solution rather than trying to place blame. And good luck if you are trying to blame a public utility.

Old infrastructure, part II

Last fall, we replaced a boiler in a 1920s colonial single-family home in Massachusetts Avenue Heights, an older section of Washington, D.C., near the National Cathedral. We took out a 30-year-old standing-pilot cast iron sectional boiler and replaced it with another cast iron atmospheric draft sectional boiler. Typically, I am not shy about mentioning the manufacturers and brands I use, as it often helps to illustrate my stories. In this case, the manufacturer is not important, as this boiler uses the same Honeywell electronic ignition control and gas valve that multiple manufacturers use.

The new boiler ran fine through fall and early winter.

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In January, we had our first cold snap, with nighttime temperatures dropping into the single digits. I received a call early one morning from this client.

"Our new boiler you just installed is not firing," she said.

"No problem. I will send a tech right over," I answered.

My lead tech, Brian, found the boiler control in a hard lockout, indicating a flame failure. He reset the control and it fired. He then checked the usual causes: dirty pilot, dirty flame sensor, weak ground, manifold pressure, pilot flame, chimney draft and low voltage connections. The boiler had been in service less than three months and was spotless. Everything checked out. As this client was very upset that her new boiler had failed during the first cold weather of the winter season, I did not want to take any chances. I told Brian to replace the pilot assembly, gas valve and ignition module.

He did this and everything seemed to be OK for a few weeks. Then in early February, an arctic blast hit the D.C. area. Temperatures were below zero overnight. Early on a Sunday morning, my cell phone starting ringing, one call after another before I could even answer. My client was so frantic, I could not understand what she was saying; but I gathered that she had no heat.

She was hosting a Sunday brunch in about four hours, and it was 52°F in her living room. Not good. I met my tech, Joe, on the job and the boiler was locked out again on a flame failure code. I reset the boiler and it fired. Slowly the temperature came up just in time for the party. I showed the client how to reset the boiler and went on my way. I told her we would be back on Monday to dig deeper and find the cause of the problem.

That night, the boiler locked out again. Even though my clients were able to reset it, they were not happy. Frantic calls turned into nasty calls. My techs were berated by this client. My name was mud.

"If you can't fix this, you better replace it with one that works!"

"Take this out and refund our money!"

"The old one never gave us this problem!"

It is difficult to work or even think straight when a client is breathing fire down your neck. I sent my lead tech, Brian, with instructions not to leave until he figured out what was going on. And, he did. The challenge was that it always worked fine when we were there. The common condition was that it would lock out during extremely cold weather.

Brian was there at 7:30a.m. on a morning when the temperature was around five degrees. He fired the boiler and read gas pressure on a manometer. This boiler requires a minimum inlet pressure of 4 inches w.c. As the boiler ran, the pressure started dropping. 3.8 inches w.c., then 3.5 inches, 3.2 inches, and it continued to drop. The micro amp reading from the flame sensor started to drop accordingly. The inlet pressure dropped below 3 inches w.c. and the boiler locked out on flame failure. We found the problem.

Again, it was not a manufacturer or installation problem. The utility, Washington Gas, was not able to maintain pressure in the mains during extreme conditions. The gas mains in this neighborhood are among the oldest in the system. The street mains operate at low pressure. There is no pressure regulator on the meter to adjust. Gas runs through the meter at street pressure. In this case, we measured inlet gas pressure below 2 inches w.c. when both the boiler and water heater fired at the same time.

A technician from Washington Gas came by and declared everything was fine. He measured a lockup pressure of 7 inches w.c. at the meter. Lock-up pressure is meaningless in this situation. Inlet pressure with the boiler operating is the key number. And in our case, it was well below the manufacturer's minimum spec during cold weather.

A new meter was installed, clean-outs were checked, pipe sizes were double-checked. I finally got a supervisor from Washington Gas to call me and he acknowledged that the mains were old and this was in a low pressure zone. He also indicated that water could be collecting in the mains or lateral, compounding the problem.

I tried relaying this information to my client, but she was having none of this. She had had enough already.

"My old boiler never had this problem."

"My neighbor's boiler is not having this problem.'

"You mean to tell me I'm the only one on this street with this problem? This is ridiculous! Make it work or give me my money back!"

I have to admit that I had had enough, as well. I was at the end of my rope. This boiler had cost me countless man hours during our busiest stretch over the winter. Non-revenue-producing man hours. I did not feel that we were the cause of the problem, but what else could I do? I recommended and installed this boiler and I could not get it to work.

Again I had a low-tech solution. I removed the electronic ignition system from the boiler. I installed a standing pilot gas valve, a new pilot burner and thermocouple and an aqua-stat relay control. All safeties and limits remained in the burner circuit. It has been this way since mid-February with no problems. Now, when gas pressure drops, the boiler will not operate at rated capacity, but at least it does not lock out.

Washington Gas cannot maintain 4 inches w.c. inlet pressure in this neighborhood during extreme conditions. That is not going to change anytime soon. This is not an issue with older standing pilot equipment. We have also found it not to be an issue with high efficiency modulating boilers. With a negative pressure gas valve and a draft inducer, low gas pressure is not as much of a problem.

Just to be safe, I called an old friend at the boiler manufacturer to see if he had any suggestions. I explained to him the modifications I made to his boiler.

"Dan, what you did is illegal as he**."

He was referring to the fact that standing pilot boilers have been outlawed by the Department of Energy.

"So is charging someone $12,000 for a boiler that does not work," I responded.

The reality is that my modification is no different than any one of thousands of standing pilot boilers that left their plant before they went the way of the dinosaur. Tough situations call for tough decisions, and my solution worked.

I have a standing offer to all the manufacturers we work with. Send your engineers down to ride around with me for a day or two. See what we have to work with. See how and where your stuff gets installed. It may open your eyes.

It is easy to make it work perfectly in a laboratory. Come with me into dirty basements with old gas mains and tired electrical grids. Then let's see how easy it is to make it work. You can write whatever spec you want on paper. It may not be what you see in the field. ●

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