Seemed Like a Good Idea at the Time

There are boiler control schemes that, if not thought out carefully, can result in thousands of dollars in repairs.

BY RAY WOHLFARTH

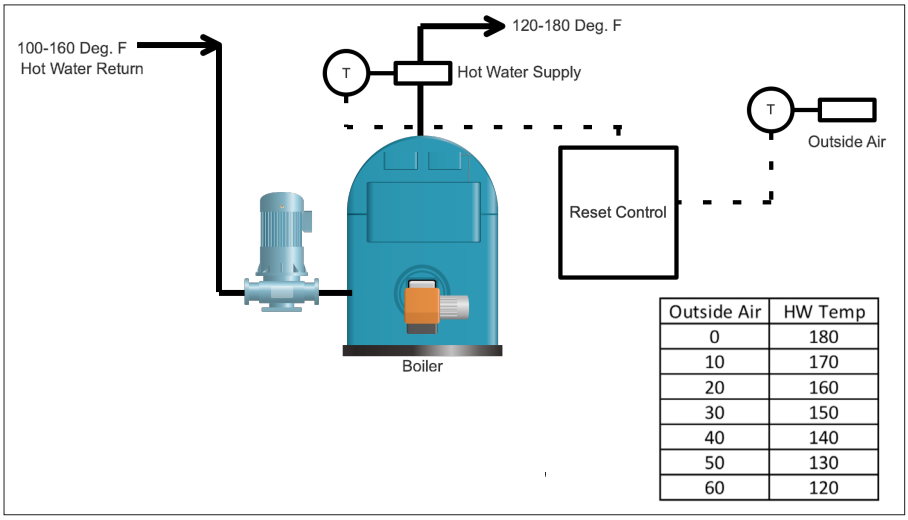
In most instances, a properly maintained boiler will last several decades. For a boiler to fail before that usually requires some human help. The following are some control strategies which seemed like a good idea initially but did not work very well.

BOILER RESET CONTROL

The contractor told the boiler owner he could save a great deal of money if he installed a boiler reset control. The salesperson showed him a bar chart detailing the estimated savings and the quick payback for the investment. He explained how the building only needed 180°F supply water on the coldest days of the year. The owner agreed, and the control was installed.

The fuel bills did indeed drop, which made the owner smile. After the first heating season with the reset control, the owner looked inside the fireside of the boiler and saw significant rust and damage. The repairs to the refractory and tubes cost several thousand dollars.

After the second season with the reset control, the fireside of the boiler required even more work. They also discovered rust and pinholes in the flue pipe. The



Outside Air	HW Temp
0	180
10	170
20	160
30	150
40	140
50	130
60	120

Be careful using a reset control on a boiler not designed for low temperatures. It could cause flue gas condensation.

owner contacted the manufacturer of the boiler and asked what would cause the damage. After sending pictures of the internal damage and showing the reset control settings, the boiler manufacturer informed the owner the damage was caused by flue gas condensation.

When flue gases condense, sulfuric, nitric, and carbonic acids are formed. This cocktail of acids can cause severe damage to the boiler, flue and chimney.

The manufacturer instructed the boiler owner to limit the reset control to 140°F return water temperature or 160°F supply water temperature. After the control settings were tweaked, the fuel usage rose slightly, but the major summer repairs were not needed.

THREE-WAY VALVE

This installer was familiar with the minimum water temperature for the cast iron sectional boiler and suggested a three-way valve be installed to regulate the supply water temperature. The boiler was set to operate at 180°F, well above the condensing temperature of the flue gases. The valve was installed, and the supply water temperature to the building was reset by mixing the colder return water with the supply water. In this manner, they were able to reset the water temperature down to 120°F while maintaining the boiler at 180°F.

Toward the end of the first heating season with the new three-way valve, the end section where the return pipe was connected began to leak. The contractor attributed the leak to the age of the boiler. The leaking section was replaced at the cost of several thousand dollars.

Shortly after the next heating season started, the section that had been replaced developed a leak. The manufacturer's representative was invited to the site and told the owner and the contractor that the section failed due to Thermal Shock.

Thermal Shock is when the water temperature difference between the supply and return is more than the manufacturer suggests, he explained. The boiler

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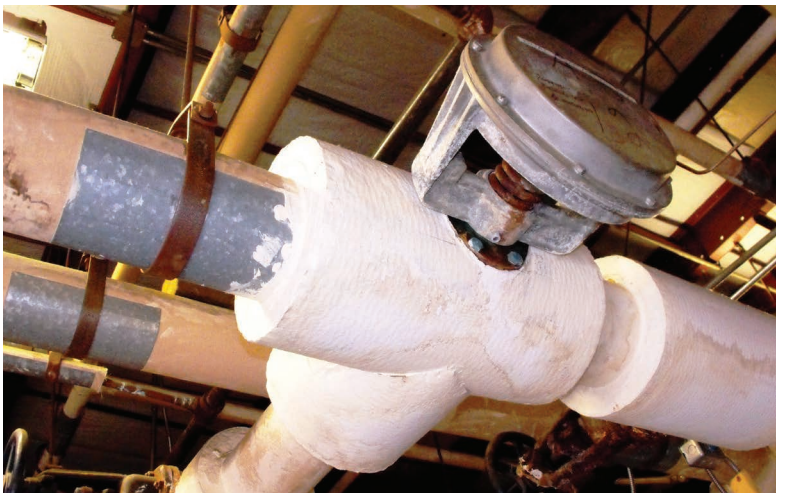

In one installation, a three-way valve resulted in return water ΔT of 60°F-80°F, and the rapid expansion and contraction damaged the boiler.

manufacturer required a temperature difference of no more than 20°F-30°F. On this boiler, the three-way valve lowered the supply water temperature to 120°F, which meant the return water was about 20°F lower. This resulted in a temperature difference of 60°F-80°F. This caused rapid expansion and contraction and ruined the boiler section.

To use a three-way valve with the boiler, the owner had to install a blend pump, which pulled hot water from the supply and mixed it with the return water. This was meant to warm the return water, so the temperature difference was within the parameters set by the manufacturer.

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ZONE PUMPS

The owner and designer discussed the replacement boiler for the building. The owner said the building was rarely filled and his office was the only area used every day. The rest of the building was vacant except for a few weekends per month. No sense heating the whole building when only one office was used, they both agreed.

The designer suggested a system using zone pumps. Each zone pump was connected to a zone thermostat. In this way, they only heated the areas where people were working. If the space was empty, the temperature was allowed to drift.

The installer sent a service technician to investigate. The service technician reported the boiler did make the noise and it also seemed to short cycle. The technician reduced the firing rate, and the noise seemed to ebb.

About halfway through the second heating season, the boiler developed a leak. A meeting was called at the job site to see why the boiler failed. In attendance were the owner, installer, designer and the manufacturer's representative. The meeting got a bit heated with the designer, owner and installer each blaming the other. The rep was quiet throughout the entire conversation and was reviewing the mechanical blueprints. He was writing numbers on a tablet and taking pictures with his cell phone. The owner called him over and asked, "So what do you think?"

"There is not enough flow. When only one zone calls for heat, the flow is insufficient for the boiler," he said. He showed them the minimum flow requirements for the boiler and the size of the circulator for the office zone—it was half the capacity.

Consequently, when designing a replacement boiler, I urge you to consult the boiler manufacturer about your design ideas and see whether they agree. A few rules of thumb I have used in my career are:

- Boiler Temperature Rise should be 20°F-30°F.
- System Temperature Drop typically should be 20°F-30°F.
- When sizing a circulator for a boiler, take the boiler output in BTUs divided by 10,000 = GPM for a 20°F rise. Or you could take the boiler output in BTUs divided by 15,000 = GPM for a 30°F rise.

Ray Wohlfarth is a columnist on boilers for several industry magazines and international author of seven books on boilers all under the Lessons Learned title. He is president of Fire & Ice Heating & Cooling in Pittsburgh, PA. He may be reached at ray@fireiceheat.com.