Boiler Facts

Can you reset a steam system?

by George Carey

I recently was presenting a steam seminar and was asked the following question: "How do you reset a steam system?"

The question came up because we were discussing different ways to save fuel consumption with steam heating, especially in commercial buildings (apartments, condominiums, etc…). Technically, you can't reset steam, at least not in the traditional manner, like we do with a hot water heating system.

When resetting hot water, of course you can change (reset) the temperature of the water delivered to the terminal units (radiation) according to the outdoor temperature. The theory is that when the outdoor temperature is at design conditions (coldest day), the boiler should provide the design water temperature (warmest water) to the system's radiation. Typically, this design condition happens for 3-5% of the heating season. For the rest of the season, because the outdoor temperature is warmer than the design conditions, the water delivered to the radiation can be cooler than it would be at design conditions. This reduction in water temperature saves on fuel consumption and makes for a more comfortable heating system.

If we can't change the temperature of the steam based on outdoor temperatures, what can we do? The next best thing with a steam system is to control or reduce the amount of "on-time" that the burner/boiler has to operate. In a residential system, this would normally be controlled by the thermostat; in a commercial application (apartment buildings, etc…) however, the problem has always been where to locate the thermostat.

Every tenant or condominium owner may have a slightly different idea of what constitutes comfort, and whoever has the thermostat becomes the boss. A better choice for improving the operation of the steam boiler, reduce its amount of operation and still provide comfort to the building is to use a heat-timing control that is typically located in the mechanical room.

The principles behind the operation of this timing-control are very straight forward. In theory, back on day one when the system was designed, the amount of radiation and the size of the boiler installed in the building were designed to keep the building warm on the coldest day of the year (design conditions). The steam control is set-up with this design condition information. The control then operates on heating cycles (typically 60 minutes in length for commercial applications). During each cycle, the control calculates the amount of time the boiler should be on making steam for the heating system. It also calculates the amount of time the boiler should be off to prevent overheating and save fuel consumption.

To accomplish this, the control has a sensor wired outdoors to measure the actual outdoor temperature. The reason being, the outdoor temperature has the greatest impact on a building's heat load. As the outdoor temperature gets colder, the on-time for the boiler gets longer and the off-time is shorter for each heating cycle. Conversely, as it gets warmer outside, the boiler on-time becomes shorter, while the off-time gets longer. So, basically, this *steam system control* sits in the boiler room, and based upon some initial design condition settings, fires the boiler on for a period of time and keeps it off for a period of time for the duration of the heating cycle.

Some "heat-timing" steam controls have additional features that allow the control to be "tweaked" for each specific building or application. For example, in addition to having an outdoor sensor that measures the outdoor air temperature, some controls provide a condensate sensor or "steam-established" sensor. This sensor has two functions. When the control turns the boiler on to make steam, the control will start counting the number of minutes the boiler should be on for this particular heating cycle.

But when you think about it, just because the boiler turned on, is there really any steam/heat out in the radiators yet? The answer is no because before the steam makes its way out to the radiators, it has to heat the piping system first…and that is where the condensate sensor's first task comes into play. It is ideally located near the end of a steam main out in the building. The control waits for the sensor to measure some temperature (set up in the control) before it says, "*OK, steam has been established in the system, now start the heating cycle on-time for the boiler.*"

Now, after the boiler has run for a period of time as determined by the control, it turns off and stays off for the duration of the heating cycle. Normally, after the heating cycle is completed, it will start all over again. The control will look at the outdoor temperature, calculate a new on-time (if necessary) and start the cycle again.

But the second job of the condensate sensor is to retard the start of the next heating cycle if there is still some remaining temperature at the sensor. The theory being if there is residual heat in the pipes, all the steam should have been used (condensed) before the control starts the next heating cycle. The last thing you want to have is an overheated building with occupants opening windows looking for relief. That does nothing for saving on fuel consumption!

Another feature some of these controls offer is the ability to add indoor sensors that are wired back to the steam control. By including the

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additional feedback of actual indoor air temperature, the control will be able to fine tune its calculation for the amount of on-time and off-time for each heating cycle. This additional information can really help improve the fuel savings a building can achieve as well as ensure a properly heated building.

If you have customers who own or manage commercial steam heated buildings, and they are coming to you looking for ideas on how to save fuel consumption, you should consider one of these "heat-timing" controls. However, the control by itself can't improve a faulty distribution system.

It is imperative that one or more large capacity main vents be installed near the end of each supply main. The vents will allow the air to escape from the piping quickly, thus allowing the steam to reach the end of each main efficiently. By allowing the steam to reach the ends of mains quickly, the condensate sensor will "sense" temperature faster and allow the control to enter its heating cycle faster, thus conserving on fuel consumption.

Without these main vents, the air in the mains will slow the steam from making its way to the condensate sensor. This will delay the control from starting its countdown in the heating cycle. When the steam finally gets to the end of the main and the condensate sensor "senses" the temperature in the pipe, parts of the building (areas closer to the boiler room) will have already started to overheat and those tenants will probably start opening their windows for relief! The property manager or building owner will be on the phone asking you why you sold them this "d*mn" control since they already had these complaints without spending the extra money!

If your customer wants to conserve on fuel usage, INSULATE the mains.

One other area of concern is the insulation of the steam mains. If your customer wants to conserve on fuel usage, INSULATE the mains. There was a reason the old-timers wrapped the pipes back on day one! A bare piece of steel pipe loses five times as much heat as an insulated pipe. By insulating the mains, the steam has a much better chance of getting to the ends of mains and up the risers to the radiators…where the people live!

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