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Understanding barometric dampers

Controlling boiler draft saves heat and reduces operating costs

By Ray Wohlfarth
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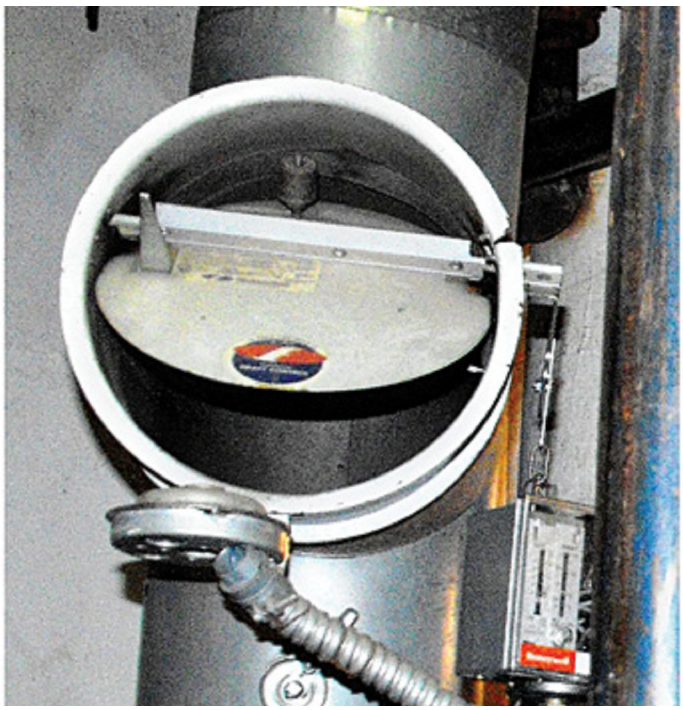

One of the most misunderstood components inside a boiler room is the barometric damper, which is used to control the draft inside a boiler. It is installed on boilers that use a Category I vent. To understand how the barometric damper operates, we need to understand what draft is. We all know that when air is heated, it will rise. When hot air from the boiler rises up the stack, it must be replaced by cooler air surrounding the boiler. This cooler air will push the warmer air up the stack, causing flow. This flow of air from the boiler up the stack to the outside is referred to as draft. It also is called “chimney effect.”

The speed or velocity of the flue gas draft is affected by many conditions such as temperature difference between the inside and the outside of the building, wind fluctuations, chimney height, burner firing rate and barometric conditions. It changes constantly.

On cold days, the draft may be very high. In some instances, excessive draft could actually pull the flame off the burner. In lesser conditions, it could simply pull the heat more quickly than desired through the boiler. This wastes money as the heat does not have time to transfer to the boiler. Instead, it is wasted up the stack.

During cold startups, the cold stack may allow spillage of the flue gases into the boiler room until the stack warms enough to sustain draft.

Chimney effect is sometimes experienced in tall buildings. Here, in my hometown, a large commercial building once had some real issues from the excessive chimney effect in the building. The main entrance to the building used to have a set of double doors with a small vestibule, which was directly in front of the main escalators for the building. During the rush hour on a cold morning, the negative conditions inside the building would be very high. When both sets of doors were opened simultaneously, the wind would whip into the building at high velocities.

The building owners were forced to replace the double doors with large revolving doors in an effort to combat the building's chimney effect.

On another building, the engineer factored the building draft into his HVAC design and made a system using the chimney effect to provide free ventilation to the building without fans.

Buffer solution

When a tall chimney is attached to a boiler, the draft readings will vary greatly. The boiler requires a stable environment and the chimney is like the "wild child." Most older boilers were designed to have a draft at the outlet of the boiler to be about -0.05 in. water column. The draft conditions inside the chimney could cause swings of 10, 20 or even 100 times that amount. How do you provide a buffer to handle these erratic swings?

A barometric damper is a great solution. High draft will pull the flue gases too quickly through a boiler, not allowing the heat to be transferred into the boiler. The barometric damper is installed in the flue between the boiler and the chimney. It is set for the desired draft conditions using weights and adjustment screws. If the draft inside the chimney is greater than the setpoint, the damper will open and allow air from the boiler room inside the chimney, rather than stealing heat from the boiler.

Draft controls are typically used when the stack or chimney height is greater than 30 ft. Excessive draft inside a boiler can cause other strange behaviors. In addition to increased operating costs, the high draft can cause flame impingement on the boiler. This could develop higher than desired levels of carbon monoxide.

Flame impingement also could cause embrittlement of the boiler metal, lowering the life of the boiler. Embrittlement is the loss of ductility of the metal. It is similar to what happens when you keep bending a paper clip. It will eventually break. Flame impingement means the burner flame is touching the metal surfaces of the boiler that were not designed to have flame directly on them.

We had a vertical fire-tube steam boiler where the flame was drawn into the rear tubes of the boiler. It caused violent surges and waves inside the boiler. This caused wet steam and tripping of the low-water cutoff. Excessive draft also can cause the burner to overfire. If the gas pressure regulator is set for a certain pressure, the high draft can actually pull more gas through the regulator, overfiring the boiler.

Barometric dampers are only installed on boilers with negative venting. Boilers with pressurized vents would spill flue gases out of the barometric dampers into the room.

When choosing a barometric damper, there are two types: single- and double-acting. A single-acting damper has a stop that only allows the damper to swing one way. A double-acting one allows the damper to swing two ways. The single-acting damper will close if pressure exists inside the stack. The double-acting damper

will actually allow spillage of the flue gases into the boiler room in the event of blocked flues or downdrafts.

I know that sounds crazy. It is why I like seeing spill switches on the barometric damper. If spillage from the barometric damper gets into the boiler room, this switch will sense it and shut off the burner. In some locations, installation of spill switches is part of the boiler code.

Each fuel or combination of fuels requires a specific type of barometric damper. Single-acting is traditionally used for oil-fired burners and double-acting is used for gas burners. The stops found in double-acting dampers should be removed if only firing with gas.

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Ray Wohlfarth is the author of “Lessons Learned in a Boiler Room: A common-sense approach to servicing and installing commercial boilers.” In his spare time, he is president of Fire & Ice in Pittsburgh, Pa. Ray writes a monthly newsletter on commercial boilers. He can be reached at 412/343-4110.