



A Failing-Furnace Mystery

by J.D. Ned Nisson

A very high-efficiency condensing furnace was installed in the basement of a single-story house. The two-inch PVC flue pipe was run up into the attic, horizontally about 15 feet, then up and out through the roof.

When the furnace was fired up, it ran for a while but then shut down. After a period of time it could be fired up again, but then would shut down again. The manufacturer, seeking to avoid a bad reputation for the appliance, replaced the furnace with a new unit but the problem persisted. What was wrong?

The new, high-efficiency, direct-vent and induced-draft boilers and furnaces have, for the most part, simplified and reduced the cost of installation. Most of them are side-venting and don't need chimneys. But along with the simplification have come a few pitfalls to watch out for. The above story is an example of one.

Before we look at the happy ending to that story, let's look at some background information to help understand what actually happened.

Condensing Furnaces and Boilers

When any fossil fuel is burned, one of the by-products of combustion is water vapor. If the flue gases from any combustion appliance are cooled low enough, some of that water vapor will condense into liquid water.

In low-efficiency boilers and furnaces, which typically have high flue-gas temperatures, that rarely happens. But the new, high-efficiency appliances gain their efficiency by extracting as much heat as possible from the flue gases, thereby lowering the temperature close to or below the dew point (the temperature at which condensation will occur).

If the flue gases are cooled below the dew point within the appliance's heat exchanger, then the appliance is called "condensing." Condensing heating appliances have efficiencies (AFUE) of 85 percent or higher. An important point to realize, however, is that even though condensation occurs inside a condensing appliance, not all the water vapor is removed from the flue gases; further condensation can occur within the flue pipe before the flue gases leave the house.

Condensation with Non-Condensing Appliances

Some non-condensing appliances cool the flue gases almost to the dew-point temperature. With those units, condensation often occurs in the flue pipe if it is cool enough. In one case we know of, a highly conductive, stainless-steel flue pipe was causing condensation in the exhaust from a gas water heater. If the flue pipe is cold enough, icing can occur.

Acid Rain in the Basement?

Acid rain is generally believed to be formed from the combination of sulphur-based combustion products

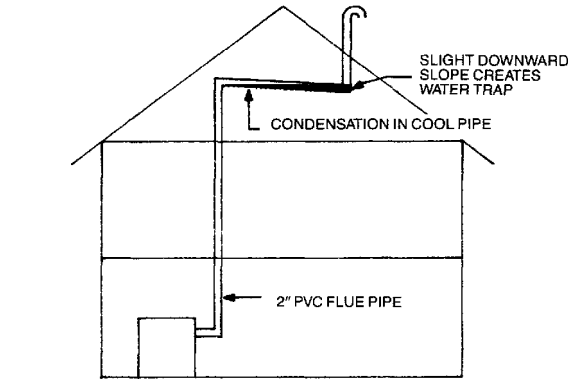


Figure 1
Condensed water collected in the downward-sloping section of the flue and shut down the high-efficiency furnace.

(from factories and power plants) with water vapor in the air. This forms sulphuric acid.

The acidity in the condensate from condensing furnaces and boilers was originally thought to be formed by a similar mechanism, since natural gas and oil often contain trace amounts of sulphur. Current thinking, however, is that the problem is not from sulphur, but rather from chlorine contained in household air.

Regardless of the source of acidity, the point to remember is that the water that condenses out of flue gases from furnaces or boilers can be very acidic.

And Now, the Rest of the Story

Our introductory story was told to us by a representative from a condensing-furnace manufacturer. (Although he asked to remain anonymous, we applaud his willingness to expose possible problems with his product rather than claiming 100 percent problem-free installations.)

The explanation for the problem in the story is really quite simple: The horizontal pipe run in the attic sloped downward slightly at the far end (see Figure 1). It may have been installed that way, or it may have been pushed down when the roof boot was installed.

In any case, since the pipe was in the cold attic, condensation occurred and the horizontal run formed a water trap, blocking the flue pipe. The furnace has an automatic pressure-sensing switch, which shuts down the furnace when flue blockage occurs, so the unit shut down whenever condensate built up in the pipe.

The problem was corrected by simply changing the slope of the flue pipe in the attic. The lesson is obvious: Avoid any situation that is even close to forming a water trap. A good rule might be to avoid all horizontal attic runs, period.

Here are a few more guidelines to follow to avoid other pitfalls related to flue-gas condensation.

Protect shrubbery and siding from condensate. Remember that the

flue gases are acidic. We have heard reports of flue gases that, when vented through a sidewall, damaged shrubbery, discolored siding, and caused paint to peel. The solution is commonsensical: Vent the flue in a location and manner that won't damage the house or garden.

When installing a PVC exhaust pipe in an existing chimney, run the PVC all the way up the chimney (Figure 2). Although it may

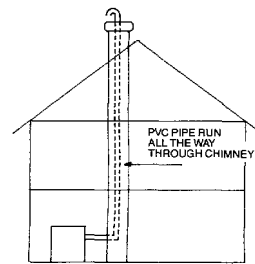


Figure 2
Run the PVC pipe all the way up the chimney when tying a condensing furnace to a masonry chimney.

be tempting to simply run the two-inch PVC pipe into an existing chimney, saving time and money, the result will almost surely be trouble. Two reasons—first, the flue gases from high-efficiency combustion appliances are cool compared to less-efficient units: sometimes the flue-gas temperature is only 90 to 100°F. At those temperatures, the gases are not buoyant enough to create sufficient draft to carry them up and out of a large-diameter chimney flue. The low-powered fan in the heating appliance is too small to drive them out of a chimney.

The second reason to run the PVC to the top is to protect the chimney, particularly the mortar joints, from the acidic condensate.

Incidentally, when running a PVC flue pipe from a furnace up through a chimney, you should never run another appliance into the same flue.

Finally, a word about outside

vertical runs. The vent configuration in Figure 3 was shown to us by a

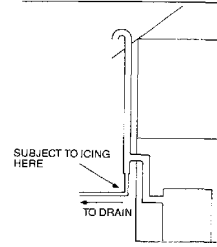


Figure 3
An outside flue pipe and condensate drain may be okay in mild climates, but in cold climates the condensate drain could ice up.

Massachusetts builder who claimed that it works just fine. The potential problem is that the condensate drainage system could ice up. In very cold climates, it is surely not a good idea. ■

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