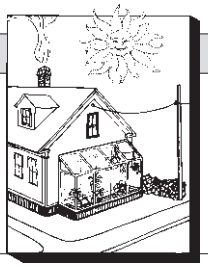
Induced-draft Furnace Venting



by J.D Ned Nisson

A happy gas appliance is one that has a good supply of air plus a proper way to exhaust the byproducts of combustion. Unfortunately, providing those basic needs is not as simple or as straightforward as it used to be.

In the old days (six to ten years ago), things were easy. Those old 60%-efficient furnaces and boilers produced plenty of hot, dry flue gases which could easily force themselves up almost any chimney. Little if any "design" was necessary for the vent system. Today's gas appliances, however, have improved efficiency which means less flue gas at a lower temperature.

To ensure proper venting without corrosion problems, the vent system must be designed for the specific appliance. The problems are not with high-efficiency, condensing appliances which vent through plastic vent pipe, but with mid-efficiency (78% to 83%) natural-draft furnaces and boilers, which are typically vented into metal or masonry chimneys like their low-efficiency predecessors. The mid-efficiency units are less forgiving and more susceptible to spillage and condensate problems if not properly vented (see illustration).

Another new concern with all gas appliances is combustion air quality. Since flue-gas condensate can and does form in most gas systems (even "non"-condensing units), the combustion air should be free of chemicals such as chlorides and fluorides which make the condensate corrosive to metals.

Selecting the Proper Vent System

Natural-draft furnaces and water heaters rely on the buoyancy of the hot flue gases to carry them up through the vent system. Some mid-efficiency natural-draft appliances are fan assisted, meaning they have an inducer fan to help draw combustion air through the appliance. But those fans are not powerful enough to force gases out of the house. The system still relies on natural draft for venting. These mid-efficiency appliances with fan-assisted draft should not be confused with high-efficiency direct-vent systems. The high-efficiency systems have a more powerful exhaust fan and are vented through sealed plastic vent pipe.

Mid-efficiency natural-draft appliances have two problems. The first is that the relatively cool flue gas (300°F to 400°F) does not create a strong draft in the chimney or vertical vent, which makes the system susceptible to spillage and backdrafting. The second problem is that even though the temperature of the flue gas is well above the dew point temperature (135°F) during normal operation, condensate still forms in the vent system during start-up and cool down. Unless it dries quickly, the corrosive condensate can damage the vent system. An even worse situation can arise if the appliance is vented into a masonry chimney on an exterior wall. In cold climates, condensate may form continuously in the chimney whenever the furnace or boiler is operating.

The general solution to both problems is to install a vent system that is not oversized and keeps the flue gases warm over the entire path from furnace or boiler to termination outside the house. Although not everybody in the industry agrees on the best way to accomplish those goals, there are a few suggestions which should help reduce or avoid problems. (Note: Some of the following suggestions are based on new guidelines being developed as part of the "Venting/Flue Gas Management Project" sponsored by the Gas Research Institute and conducted at the American Gas Association Laboratory, in Cleveland.)

The Vertical Vent or Chimney

The most common and best material for the vertical vent and mid-efficiency appliances is regular double-wall B-vent. Typical B-vent has an aluminum inner wall and galvanized steel outer wall. The air space between the two walls serves as insulation to keep the inner surface warm.

Problems can occur, however, with masonry chimneys. Although codes allow them to vent natural-draft gas appliances, masonry chimneys may suffer condensate problems with mid-efficiency appliances in cold climates. Brick and tile are poor insulators and masonry chimneys are often located on exterior walls. The result is a cold vertical vent and high condensation potential.

If a masonry chimney is used, it must be lined with an approved tile or metal liner. No gas appliance should ever be vented into an unlined masonry chimney. If an existing masonry chimney is being used for furnace or boiler replacement, it should be visually inspected to determine if the liner is sound. If not, the chimney should be relined using a UL-listed liner.

The most common liners are single-wall flexible aluminum or stainless-steel tubing. Since single-wall pipe does not reduce the potential for condensate formation, the lining should preferably be AL29-4C stainless steel. (Some manufacturers have recommended Series 300 stainless-steel liners, but recent AGA research indicates that Series 300 stainless steel is highly susceptible to pitting corrosion.) At least one manufacturer (Simpson Dura-Vent, Vicksburg, Miss.; 800/227-8446) makes a double-wall B-vent metal liner which should effectively limit condensation.

The Vent Connector

The "vent connector" is the short length of flue pipe that connects the draft hood to the vertical vent or chimney. It is typically made from single-wall galvanized pipe, but double-wall B-vent will improve performance and reduce the potential for condensate formation here. There are no specific guidelines as to when to use B-vent, but if the vent connector passes through an unheated space, then B-vent is a definite best bet. AGA recommends that no more than 5 feet of single-wall vent connector should be used in any venting system for mid-efficiency furnaces or boilers.

The vent connector should be as short, and with as few elbows, as possible. Horizontal runs must slope up from the furnace or boiler at a minimum 1/4 inch per foot.

Sizing the Vent System

For most typical installations, the vent connector and vertical vent will be either 3-inch or 4-inch diameter pipe or 4x8-inch nominal tile flue liner. To ensure proper venting and to minimize condensate formation, the smallest diameter vent that can carry the appliance capacity should be used.

For years, the authoritative method to size the vent system has been the capacity tables in the National Fuel Gas Code (NFGC). Unfortunately those tables, developed during the 1950s, are for draft-hood appliances in the 65% to 75% AFUE range. AGA is now developing new tables that will include both maximum and minimum vent sizes for fan-assisted natural draft gas appliances. Until the sizing tables in the NFGC are revised, it is recommended that the smallest size capable of handling the input load be selected.

Side Venting Mid-efficiency Furnaces and Boilers

Any mid-efficiency gas furnace or boiler can be side vented using an add-on draft-inducing fan (available from The Field Controls Company, 2308 Airport Rd., Kinston, NC 28501-8947; 919/522-3031 or Tjernlund Products, Inc., 1601 9th Street, White Bear Lake, MN 55110; 612/426 2993). The obvious advantage is that the chimney is eliminated. In cold climates, however, side venting can create other problems. Condensate can freeze on the side of the building below the vent. Also, in windy locations, backdrafting is sometimes a problem. If possible, side-vented exhausts should be located on the leeward side of the building and a flashing should be installed below the vent to protect the wall from condensate.

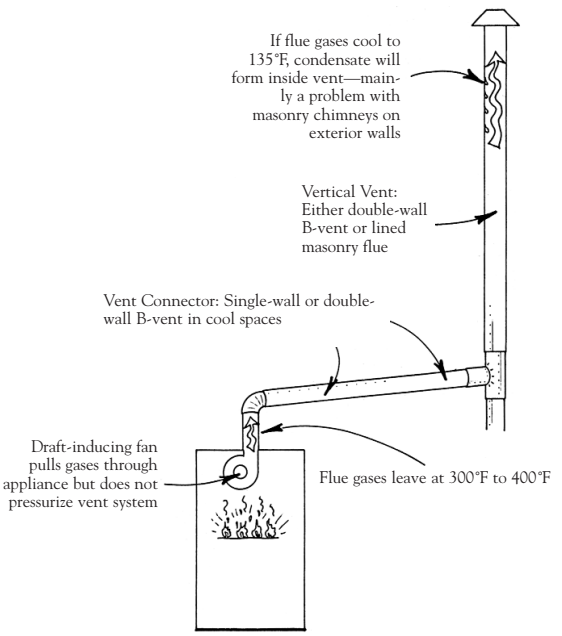
Providing Clean Air

We now know what makes flue gas condensate corrosive to metals. The culprit is hydrochloric acid and the source is chlorides in the combustion air. It turns out that the air in houses is often laden with chlorides from a variety of sources—chlorinated tap water, laundry bleaches, paint cleaners, photography chemicals, refrigerants, and even kitty litter. I recently heard a fantastic story of a meticulously germ-conscious mother who soaked all her baby's diapers in bleach and then dried them in front of her nice, warm brand new furnace. The furnace heat exchanger and vent pipe both rusted out completely during the first winter. But even in more commonplace situations, the chlorides in indoor air can create corrosive condensate in the appliance and the venting system.

The solution to the chloride problem is either to locate the furnace or boiler where there are few sources of chloride or use outdoor air for combustion. At this time, there are no mid-efficiency appliances made with outdoor combustion air intakes. If the indoor air is unsuitable for combustion, the only alternative is to move up to a condensing appliance, many of which now come with optional outdoor combustion air intakes. ■

J.D. Ned Nisson is president of Energy Design Associates Inc., a New York City-based building systems consulting firm, and editor of Energy Design Update, *a monthly technical newsletter on energy-efficient building design and construction, published in Arlington, Mass.*

Venting for Mid-Efficiency Gas Furnaces or Boilers



Flue gases from mid-efficiency "induced-draft" gas appliances can condense in the venting system and lead to corrosion. To prevent such problems, both the vent connector and vertical vent should be sized properly (not too large) and preferably use double-wall B-vent. Despite the exhaust blower, these appliances still rely on natural draft for venting.