

# Combustion Air for Furnaces

Gas and Oil : Part 1

From ASHI@HOME by Carson Dunlop

## COMBUSTION AIR IS NECESSARY FOR BURNING FUEL

such as gas, oil and wood. For a furnace to work properly, it must have an adequate supply of combustion air. The fire triangle calls for fuel, oxygen and an ignition source to have successful combustion. In this discussion, our focus is on gas furnaces that are obtaining combustion air from inside the home. These would include natural draft and induced draft furnaces. For simplicity, we will use the example of a conventional gas furnace, even though these systems have not been installed in a very long time. Any of these you see in the field are typically near or past their life expectancies.

### Natural-draft Burners

Burners in conventional gas furnaces are natural draft. This means that we are not blowing any air into the combustion chamber to create an artificial draft condition (this is forced draft), nor are we pulling air through the combustion chamber on the exhaust side, again creating an artificial draft condition (this is induced draft).

### Need 30 Feet of Air For Every Foot of Gas

Furnaces need both combustion air and dilution air. The requirements are about 15 cubic feet of combustion air and 15 cubic feet of dilution air for every cubic foot of gas burned. Since a cubic foot of natural gas contains about one thousand BTUs, a furnace that fires at the rate of 120,000 BTUs per hour would use 120 cubic feet of gas if it fired constantly for 60 minutes. This means that it would use two cubic feet of gas per minute.

We need about 60 cubic feet of air per minute (30 x 2) to ensure proper operation of this furnace. This is similar to the capacity of a typical bathroom exhaust fan. If we put the furnace in a closet and seal it off, it won't have enough air to work properly.

## Not Enough Air

The available air in a closed room 5 feet by 5 feet by 8 feet tall is 200 cubic feet. This would be consumed very quickly by a furnace firing at this rate. If the room could not easily replace the air, the room and the furnace would be under negative pressure, relative to the chimney.

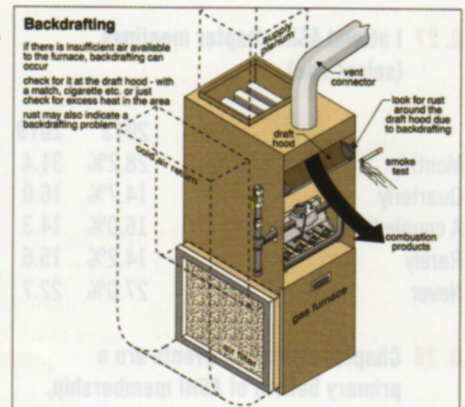
## Implications

The implications of inadequate air are significant. The incomplete combustion process will generate carbon monoxide (the poisonous gas). Further, the lack of dilution air is likely to result in backdraft. This means that combustion products can't go up the chimney but are dumped back

into the room, which is under low pressure (since it's starved for air, because we've pulled all the air into the furnace for the combustion and dilution process). Some people call backdrafting spillage.

## Strategy for Checking for Spillage

When a furnace is operating, it's easy to look for spillage or backdrafting through the draft hood. Some people use a match or smoke candle. However, in most cases you can tell simply with your hand. When you put your hand into the base of the draft hood, you should feel cool room air being drawn in. If you feel hot, wet exhaust air coming down onto your hand, spillage is taking place. With a little bit of practice, you can readily identify this. Don't mistake the radiant heat from the hot flue as a downdraft.



### Spillage on Start Up Normal

It's normal to have a little bit of spillage when an appliance starts up. The heavy column of cool air in the chimney has to be overcome for the appliance to vent properly. Until the chimney is warmed by the exhaust products, spillage may occur. This should be overcome within the first minute or two of operation.



The staining is evidence of backdrafting as a result of negative air pressure in the home.

### Condensation

Another indication of spillage is condensation. Because one of the products of combustion is water vapor, the exhaust products will condense as they come back into the room. The dew point of combustion products is around 125°F. As the gas is cooled, it may cause quite a bit of condensation. Rust around the draft hood may indicate a chronic spillage (backdrafting) problem. Corrosion is a common result of condensation.

### Slow Exhaust Movement

Condensation may also occur if the draft is marginally adequate. If the gases don't move quickly enough through the vent connector and up the chimney, they may cool below their dew point and condense although the exhaust products eventually get out of the building. This is usually the result of a furnace too small for the chimney or an appliance firing at too low a rate to have the venting system work properly.

### Poor Draft or Obstructed Chimney

Both a blocked chimney and a downdraft in an open chimney will create spillage when the appliance is running. Using this test when the appliance is off, you can get an idea of which condition is causing the problem. In some cases, you can look up or down the chimney and see an obstruction. The obstruction may be in the vent connector (the pipe leading from the furnace to the chimney).

### Enclosed Space

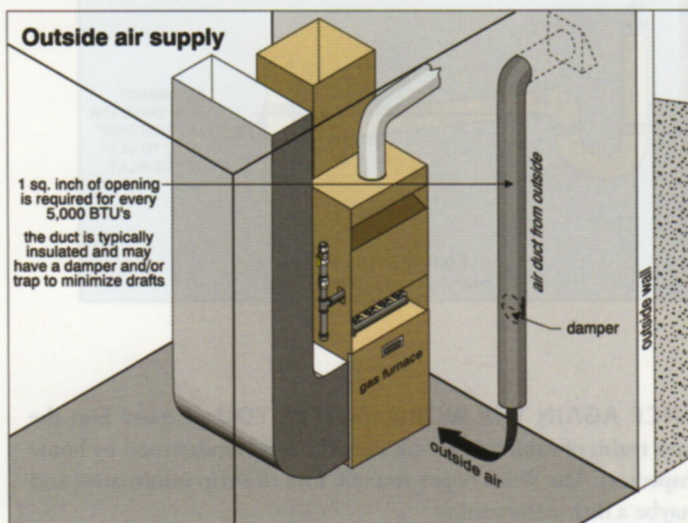
Combustion air is usually considered readily available from the house air as long as the furnace is not in a small enclosed space. Where the furnace is so enclosed, openings in the room should be provided to ensure there is adequate air.

### What's an Enclosed Space?

When a furnace is in a room that has less than 50 cubic feet of air for every cubic foot of gas (1,000 BTU/hr), vents are needed in the room. The openings have to allow access to a space that has an adequate volume of air. It does little good to add openings to an adjacent small space. You have to consider the sum of the BTU/hr of all the appliances within the space.

### Opening to Outdoors

One of the other ways to get adequate combustion air to the burner is with an opening to the outdoors from the furnace room or enclosure. Where the furnace is in a basement, crude ductwork typically runs from the screened hole in the outside wall down to near the floor level, close to the burner. In some cases, a trap is created to minimize the cold draft. In this case, one square inch of opening is required for every 4,000 BTU.



The causes of inadequate combustion air include the following circumstances:

- The furnace is in a small enclosure that cannot provide adequate combustion and dilution air.
- The house is too tight.
- There are too many other pieces of equipment exhausting air (kitchen and bathroom exhaust fans, clothes dryers, water heaters or fireplaces, for example) to provide adequate combustion and dilution air for the furnace.

The implication is incomplete combustion and carbon monoxide entering the house. This is a life-safety issue.

We have briefly introduced the topic of combustion air requirements for gas furnaces. More information is in the ASHI@HOME training program, with in-depth discussions on specific combustion air requirements for other types of appliances, as well as implications and strategies for inspection. ■

### ABOUT ASHI@HOME

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