



How to Provide Makeup Air for Range Hoods

If your kitchen has a powerful exhaust fan, it may be making your indoor air worse

BY MARTIN HOLLADAY

When Cheryl Morris moved into her new home, she realized that the kitchen exhaust fan was probably too powerful. Whenever she turned on the 1200-cfm fan, strange things happened. “It pulled the ashes out of the fireplace, halfway across the room, right up to my husband’s chair,” she says. Those dancing ashes demonstrate an important principle: Large exhaust fans need makeup air.

The air that fans remove has to come from somewhere

Most homes have several exhaust appliances. They can include a bathroom fan (40 cfm to 200 cfm), a clothes dryer (100 cfm to 225 cfm), a power-vented water heater (50 cfm), a woodstove (30 cfm to

50 cfm), and a central vacuum-cleaning system (100 cfm to 200 cfm). The most powerful exhaust appliance in most homes, however, is the kitchen range-hood fan (160 cfm to 1200 cfm).

Although tightening up homes is a good way to make them more energy efficient, builders need to remember that plugging air leaks makes it harder for air to enter a home. Every time an exhaust fan removes air from your house, an equal volume of air must enter. If a house doesn’t have enough random air leaks around windows, doors, and mudsills, makeup air can be pulled through water-heater flues or down wood-burning chimneys, a phenomenon called backdrafting. Because the flue gases of combustion appliances can include carbon monoxide, backdrafting can be dangerous.

Three ways to provide the makeup air you need

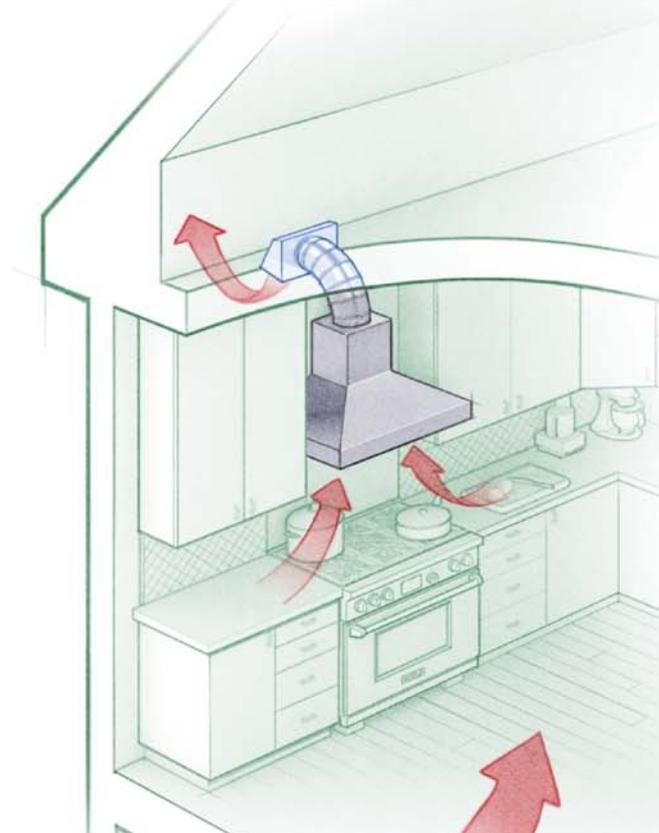
The IRC requires a dedicated makeup-air system for range hoods that are larger than 400 cfm. The necessary outside-air duct is usually connected to a wall or ceiling grille in the kitchen or directly connected to the return-air plenum of your furnace. As long as the duct dumps the makeup air into your home, however, it can dump the air almost anywhere.

Although an outdoor-air duct connected to a motorized damper solves the makeup-air problem, it can still lead to comfort complaints if the air isn't conditioned. This problem can be reduced by hooking the outdoor-air duct to your furnace plenum. If your house doesn't have a forced-air heating system, however, you'll need to investigate other solutions.

One solution is a powered makeup-air unit that tempers incoming air during the winter with electric-resistance heating coils. Such units include a supply-air fan wired to turn on when the kitchen exhaust fan is activated. Electro Industries has one such system (model EM-WH1025K; about \$1800), which includes a 10,000w heater and a blower, and can supply 632 cfm of makeup air while maintaining a 50°F temperature rise.

A 1200-cfm range hood would need two of these units. In addition to their high upfront cost, these systems carry a severe energy penalty whenever they are turned on.

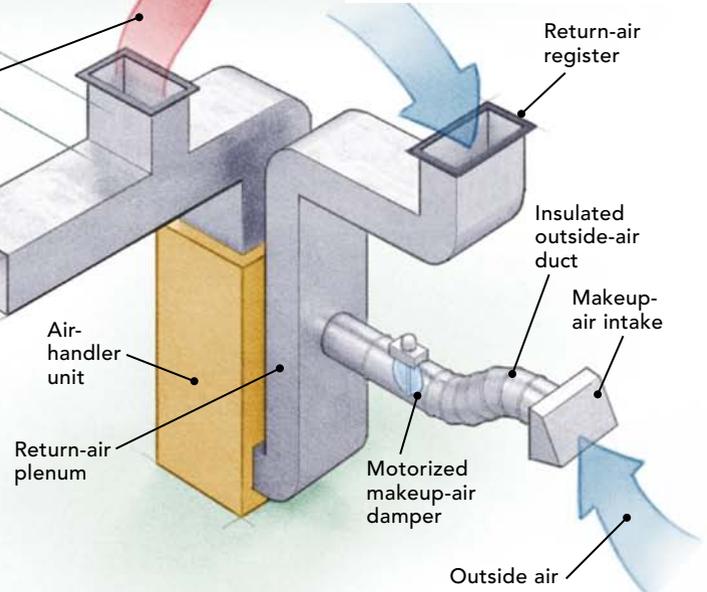
Motorized dampers are tight. Barometric dampers are bad for makeup-air ducts because they are leaky. Motorized dampers have a tight seal, and when installed in a makeup-air duct, they can be wired to open when a range-hood fan is turned on. **Sources:** Broan.com; Aprilaire.com



1. Add makeup air to your HVAC system

As long as the outdoor-air duct brings air inside, it will be able to supply makeup air whenever the motorized damper is open and the range hood depressurizes your home. Outdoor makeup air can be ducted to the return plenum of a forced-air furnace. If the furnace is running, makeup air is discharged through supply registers. If the furnace is not running, makeup air can be pulled through return registers or supply registers, depending on which is closer to the range hood that is drawing the makeup air.

Makeup air can be delivered through supply-air or return-air ducts.



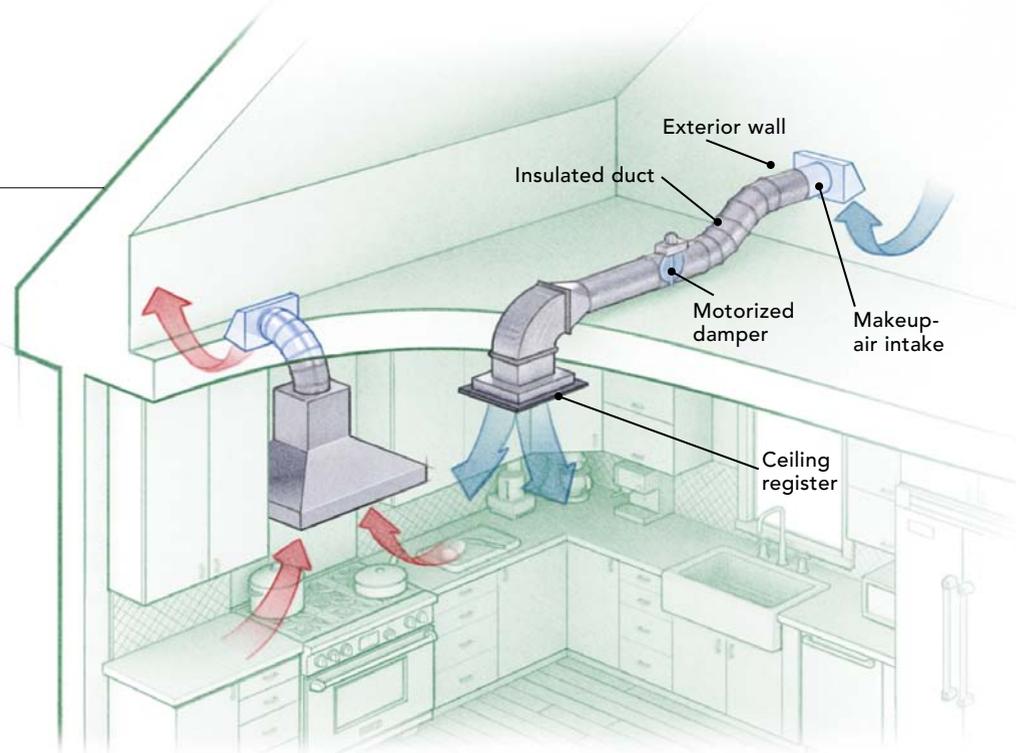
One important way to limit backdrafting problems is to avoid installing a wood-burning fireplace or any atmospherically vented combustion appliance. Appliances in this category include gas-fired or oil-fired water heaters, furnaces, and boilers connected to old-fashioned vertical chimneys or flues. Instead, install sealed-combustion appliances with fresh-air ducts that bring combustion air directly to the burner. Most sealed-combustion appliances are practically immune to backdrafting problems.

Small exhaust fans—those rated at 300 cfm or less—usually don't cause backdrafting problems. Anyone planning to install a big fan

(400 cfm or more), though, needs to provide a dedicated source of makeup air. As a stopgap measure, it's possible to open a window every time the range-hood fan is turned on, but this solution won't satisfy most homeowners. Moreover, builders who suggest this remedy may still be legally liable for future backdrafting problems.

A ventilation system isn't a makeup-air system

Most U.S. homes include a forced-air distribution system for heating or cooling. Just because your house has ducts, though, doesn't mean that you have a makeup-air system. Some new houses (especially

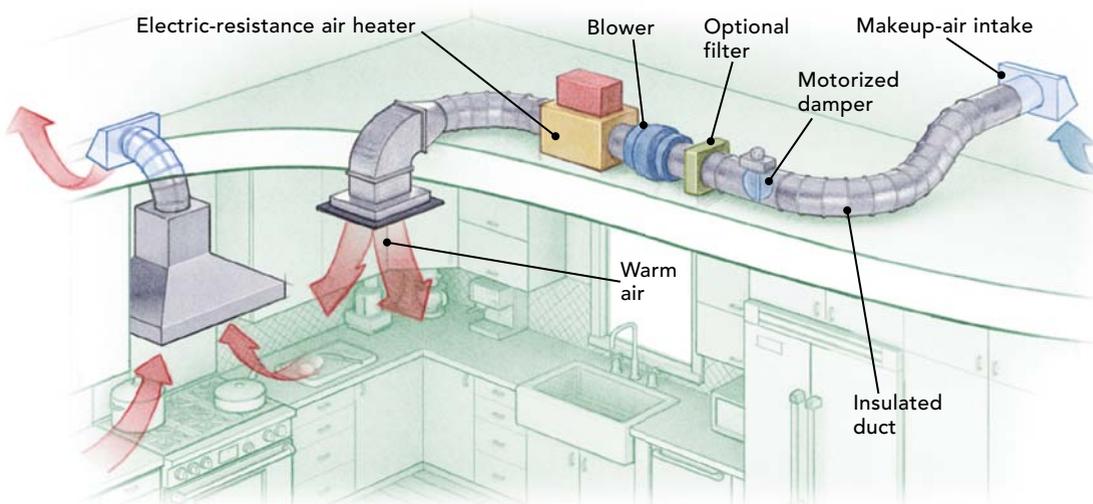


2. Makeup air for homes without a furnace

In homes without forced-air ductwork, makeup-air ducts usually terminate in a ceiling- or wall-mounted grille in the kitchen. When introducing outdoor makeup air, be sure to choose a delivery location that won't lead to comfort complaints.

3. Powered makeup-air solutions

You can add a heater and a blower to the through-wall solution, but it costs a lot to buy and a lot to operate. Makeup-air units with electric-resistance heaters are expensive and require large amounts of electricity to operate.



tight ones) also have a mechanical ventilation system to bring fresh air into the house—for example, a heat-recovery ventilator (HRV), an energy-recovery ventilator (ERV), or an outdoor-air duct connected to the furnace's return-air plenum. If you're wondering whether your home's ventilation system can provide makeup air for your range hood, the answer is no.

Why not? First, most ventilation systems include dampers and controls that open according to the anticipated needs of the occupants; this ventilation schedule has nothing to do with the operation of a range-hood fan. Second, most mechanical ventilation systems provide only

small quantities of fresh air—generally between 50 cfm and 100 cfm. That's much less than the amount of makeup air needed for a 600-cfm or 800-cfm range hood.

Some houses also include outdoor-air ducts that supply combustion air to appliances such as furnaces and boilers. In most cases, these outdoor-air ducts have been sized to meet the needs of only one appliance, so they can't be depended on to supply the makeup air for a range hood.

If you decide to install a makeup-air system for your range hood, you'll need a dedicated duct that introduces outdoor air into your

Small ducts squeeze big fans

In theory, a makeup-air duct should be at least as large as the duct connected to the range-hood fan. The sizing calculation is complicated, however, for several reasons. As an exhaust fan begins to depressurize a house, some of the necessary makeup air is inevitably drawn through cracks that exist in the building's envelope. This means that the air flowing through a makeup-air duct is only a fraction of the makeup air needed.

Also, there is a dynamic relationship between the airflow through an exhaust duct and the airflow entering a makeup-air duct. As the motorized damper in the makeup-air duct opens, some (but not all) of the necessary makeup air will begin flowing into the house through the duct. If the home's envelope is tight and the makeup-air duct is under-size, the exhaust fan won't be able to perform at its rated specification. In other words, a 1200-cfm exhaust fan may be exhausting only 900 cfm. This happens because the volume of air leaving the house and the volume of air entering the house are always balanced. If the makeup-air duct in this example were larger, the exhaust fan would experience less resistance and might be able to ramp up to 1100 cfm. These dynamic effects complicate duct-sizing calculations.

Broan recommends one 6-in. duct for a range hood up to 500 cfm, one 8-in. duct for a range hood rated at 501 cfm to 1000 cfm, and two 8-in. ducts for a range hood rated at 1001 cfm to 1500 cfm.

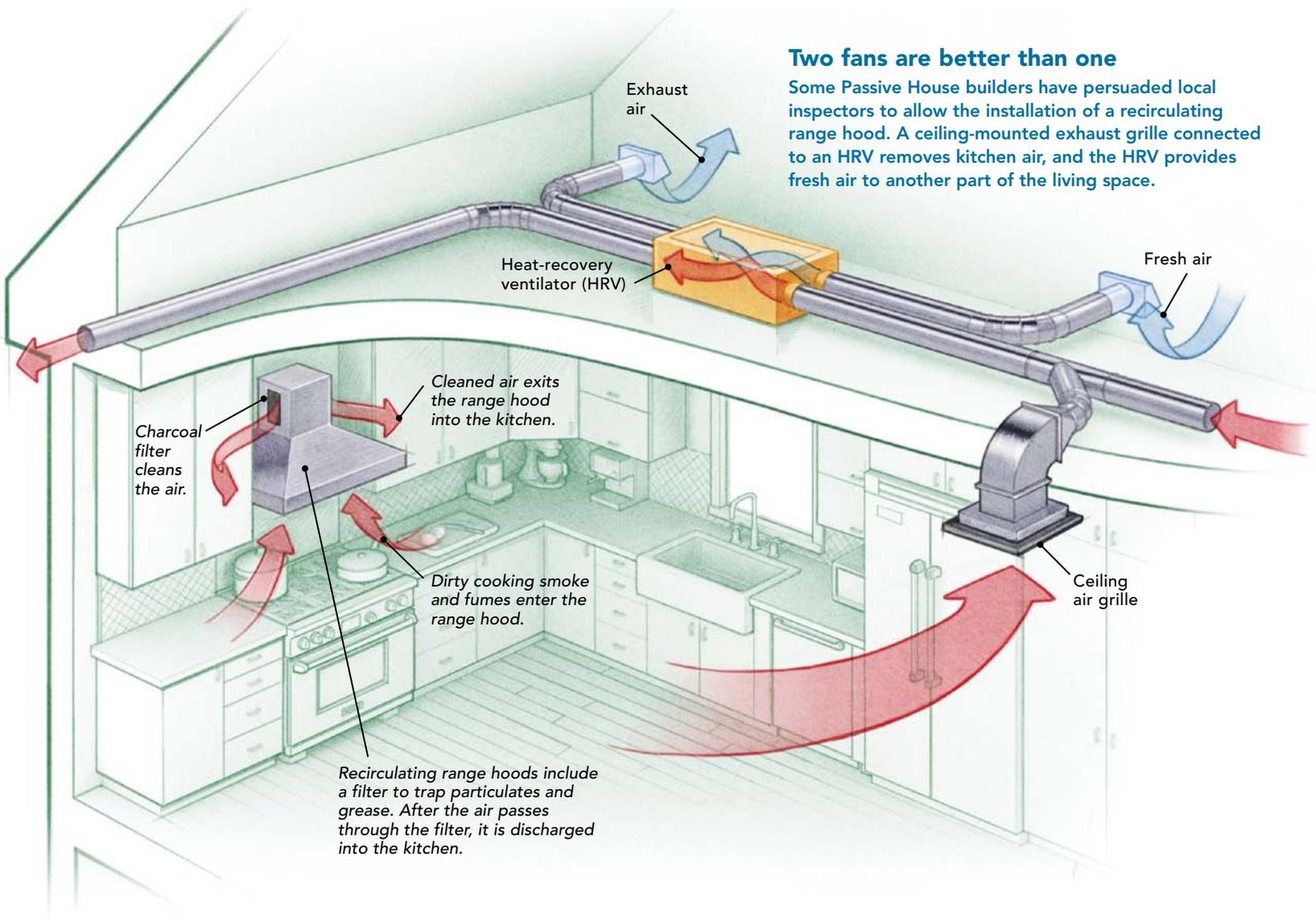
Tight-house solution: A recirculating hood and an HRV

Code requirements for kitchen ventilation vary widely from jurisdiction to jurisdiction. If your local building official is willing to accept the installation of a recirculating range hood that doesn't exhaust any air to the exterior, you can sidestep the makeup-air dilemma entirely. This approach has been

pioneered by Passive House builders, who usually try to avoid unnecessary exhaust fans or makeup-air supply ducts when they are building.

Passive House designers often specify a recirculating range hood connected to a replaceable charcoal filter. They also install

an exhaust grille on the kitchen ceiling as far away from the stove as possible. The grille is connected to the exhaust duct of a heat-recovery ventilator (HRV) system. The exhaust grille is located away from the stove to limit the amount of filter-clogging grease reaching the HRV.



Two fans are better than one

Some Passive House builders have persuaded local inspectors to allow the installation of a recirculating range hood. A ceiling-mounted exhaust grille connected to an HRV removes kitchen air, and the HRV provides fresh air to another part of the living space.

house. (In most cases, this duct will be larger than a ventilation duct.) This makeup-air duct can be connected to your home's existing forced-air ductwork if you want, but it needs separate controls from those used to regulate your home's ventilation system.

Follow the code, not the manufacturer's advice

When I contacted four range-hood manufacturers recently to ask about makeup-air requirements, the quality of the answers ranged widely. The technical advisers at General Electric were the least informed, and four phone calls all elicited the same response: "What

is makeup air?" A call to Broan was more fruitful, and a helpful representative advised, "If you start going above 300 cfm, then you might start considering makeup air, especially in a brand-new house that might be fairly airtight." Other manufacturers had answers somewhere in between: "We don't have any recommendations other than advising you to do whatever the code says."

According to section M1507.3 of the 2009 International Residential Code, the minimum rating of a kitchen range hood is 100 cfm. Section M1503.4 of the code notes that you don't need a makeup-air system for a range hood rated at 400 cfm or less.

Why can't range-hood exhaust ducts be designed to recover heat?

Many mechanical ventilation systems are designed with a pipe-within-a-pipe system that allows heat to be exchanged between the outgoing and incoming airstreams. Range hoods can't do that for two reasons. First, the pipe diameters get big fast. If your range hood requires a 10-in.-dia. exhaust duct, then the duct-within-a-

duct solution would require a 14-in. or 16-in. duct. It's hard to find that much room for ductwork in a house. Elbows compound the awkwardness.

Second (and the biggest problem with the pipe-within-a-pipe idea), the incoming cold air would cool the exhaust duct, encouraging the suspended grease in the exhaust air to congeal

and moisture in the exhaust airstream to condense. The cooling effect of the incoming air makes an exhaust duct become dirtier than if it had stayed warm. This process is similar to what happens when woodstoves are vented to outdoor chimneys; cold flues become clogged with creosote much faster than warm flues.

If your fan is larger than 400 cfm, however, you'll need a makeup-air system with a motorized damper and interlock controls. The code states, "Exhaust hood systems capable of exhausting in excess of 400 cfm shall be provided with makeup air at a rate approximately equal to the exhaust-air rate. Such makeup-air systems shall be equipped with a means of closure and shall be automatically controlled to start and operate simultaneously with the exhaust system."

If you are building a superinsulated house and, therefore, want to limit the number of penetrations in your building envelope, consider using a recirculating range hood rather than an exhaust fan.

Combined with a ventilation appliance such as an HRV, this solution works well for some families. Those who do a lot of roasting and frying, however, may not find this solution satisfactory.

The bottom line is that powerful range hoods are great for getting rid of smoke from blackened redfish, but they are difficult to integrate into a tight house. It is best to avoid exhaust fans altogether, but if you can't live without one, be sure to provide plenty of makeup air. Backdrafting from combustion appliances can be deadly. □

Martin Holladay is a senior editor.

Small range hoods don't need dedicated makeup air

Because the sizing guidelines provided by range-hood manufacturers or kitchen-equipment dealers often result in the installation of oversize fans, some experts advise ignoring such guidelines. If you choose a residential-size (30 in. wide) range, a fan rated at 160 cfm to 200 cfm will keep you out of trouble. One model you might consider is the Broan 40000 series fan (available in stainless steel for \$80); it's rated at 160 cfm.



The simple way to avoid backdrafting. Choose a range hood with a small fan. Low-cfm fans won't depressurize your house and are quiet. Sources: Broan.com; GEAppliances.com; Whirlpool.com.

