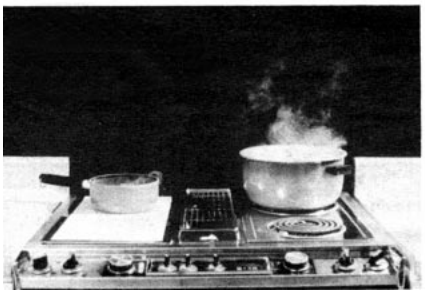
Clearing the Kitchen Air

by Wanda Olson



The hooded overhead fan (above) captures steam from both short and tall pots, even those placed on the front burner. Counter-level downdraft models (left) work well only with short pans.

Overhead hoods may not look as sleek as other models. But they still do the best job of ventilating combustion gases, moisture, and odors.

Rangetop cooking produces, among other things, water vapor, grease, smoke, and cooking odors. In addition, gas ranges produce nitrogen dioxide, carbon monoxide, and carbon dioxide. Left in the house, these gases pose health risks, while moisture poses the usual risk to the house itself.

For all these reasons, most new and remodeled kitchens these days have some sort of ventilation. But some of these units aren't up to the task before them, and fail to remove moisture and contaminants.

Here at the University of Minnesota, we tested the two main types of kitchen exhaust systems, overhead range hoods and downdraft fans, to see how well they capture cooking contaminants. We used steam from boiling water to simulate the exhaust gases, cooking odors, and moisture produced from typical cooking uses.

We found that the standard overhead range hood, properly installed, best meets the whole spectrum of exhaust needs that a kitchen might create. The two downdraft options, on the other hand, meet some exhaust needs very well while meeting others very poorly.

Before getting into the details of how hood and downdraft units perform, it's worth mentioning one type of "exhaust" fan that hardly performs at all: the so-called "recirculating" range hood. These simply filter the gases, moisture, and contaminants rising from the range before blowing them back into the room. While these units trap some grease and odor in their filters, they don't remove any moisture or noxious gases from the house. They are inadequate in any kitchen. Over a gas range, they give a false sense of security while leaving potentially dangerous gases inside the house.

Hoods

The full-size overhead range hood is the only fan design that will remove all moisture and combustion gases from all conventional cooking uses. It succeeds because hot gases and moisture rising from the rangetop naturally move into the fan's most effective collection area, rather than away from it, as happens with downdraft systems .

Overhead hoods can be either wall-mounted, hung over an island, or included as an integral part of a microwave appliance mounted over the range. Most overhead hoods have a canopy to aid in capturing contaminants. Hoods without canopies include the new pull-out "silhouette" models and microwave hoods. Our tests did not include the silhouette models.

Wall-mounted hoods. Among overhead fans, properly sized wall-mounted hoods work best, because they avoid the problems of other types, which are described below. Wall-mounted hoods should draw at least 150 to 200 cfm (see Table). The hood should be large enough to cover a large portion of the cooking surface, and should be at least 20 inches deep, rather than the 17 inches common in many models. It should be mounted 20 to 24 inches over the rangetop. Raising the hood above 24 inches, which is high enough even for tall cooks, reduces effectiveness.

Typical Airflow Rates for Range Hoods

Wall-mounted range hood	150-600 cfm
Island hood	400-600 cfm
Microwave hood	200-400 cfm
Downdraft hood	300-500 cfm

Island hoods. Most island hoods work well because of their combination of high power and complete coverage of the cooking surface. However, because they are usually in the room's center and are installed at a higher distance above the cooking surface (27 inches is typical to preserve the line of sight across the room), room air currents can diminish their effectiveness. That is why these hoods usually have such powerful fans, up to 600 cfm.

Microwave systems. The hoods that come mounted beneath microwave ovens are similar to ordinary range hoods, with two important exceptions: They don't project as far from the wall (typically only 13 to 15 inches),

Keep the Flow Going

Few exhaust fans deliver the outflows promised by the cfm rating. A recent Canadian study of kitchen exhaust fans found that their actual airflow ranged from 14% to 92% of the rated airflows; over a third of the fans produced airflows below 40% of their rated capacity. These discrepancies are typical of many installed fans.

Why the difference between rated and actual flows? Usually, the fan is not the problem — the ductwork is. Most leading fan manufacturers have their fans' flow rates certified by the Home Ventilating Institute (30 W. University Dr., Arlington Heights, IL 60004; 312/394-0150). HVI has fans independently tested to verify that the fans operate at the advertised flow rates under a standard pressure of 0.1 inch of static pressure. This is roughly equivalent to 30 feet of 3 1/4x10-inch duct venting a 200-cfm fan. Fans perform poorly when the ductwork creates resistance much greater than this.

To avoid this problem, you must keep ductwork as short and with as few elbows as possible. Jim Saffer, director of product safety for Nutone, a leading manufacturer of exhaust fans, says you're generally safe if you use the size ductwork recommended by the fan maker and keep the ductwork's "equivalent length" to 30 feet or less — not counting the wall or roof cap. Equivalent length is the length of straight runs plus the equivalent lengths (see illustration) of all elbows and transitions.

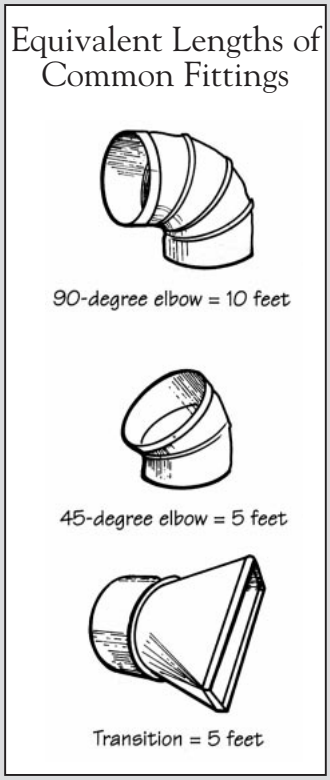
Generally, this will mean short distances from fan to cap, and no more than two elbows. For example, a run of 8-inch round ductwork with a 2-foot straight vertical section, a 90-degree elbow (10-feet equivalent length), and a 2-foot horizontal straight section running to a wall cap would have an equivalent length of 14 feet — well below the 30-foot maximum.

But let's say that the client doesn't want a wall cap blowing onto his garden, and wants you to duct his island-mounted downdraft fan down into the floor, along the floor joists to an exterior wall, and all the way up that wall to a second-story roof. You might end up with 50 feet or more, which would cut the fan's flow rate roughly 30% beyond that allowed by a 30-foot equivalent length. The result would be a poorly performing fan and probably a disappointed client.

Saffer emphasizes that the 30-foot rule-of-thumb should keep you out of trouble most of the time. He also points out that some of the highest quality fans may allow more equivalent length.

When it's not possible to keep the ductwork's equivalent length under 30 feet, Saffer suggests calling the fan's manufacturer; all the major fan makers, he says, have technical staff that can help you come up with a duct configuration that will work.

— David Dobbs



The equivalent length method is used to determine resistance to airflow created by a ductwork system. For example, a 90-degree elbow causes the same amount of resistance as 10 feet of straight duct.

and they don't have a collecting canopy, only vent openings. They do a good job of exhausting rear burners, but they miss most of the gases and vapors rising from the front burners, even if lowered as close to the cooktop as 15 inches. Because of this, their overall performance isn't that good. If cooking is limited and clients will keep the steamy stuff on the back burners, these fans can be an acceptable solution. But in most homes, you're probably better off installing the microwave elsewhere and using a conventional wall-mounted hood.

Silhouette fans. A new type of wall-mounted fan is the sleek-looking pull-out silhouette model. This has a flat horizontal shelf that pulls out for use; it stores by sliding back into a shallower cabinet. We didn't test these, but I would guess that they're more effective than hoodless microwave units, because they come out further, but not as effective as true hoods, which have canopies to aid in collecting steam and gases.

Downdraft Systems

Downdraft systems come in two types:

- counter-level downdraft units, which have vents mounted either in the center or at both sides of the rangetop; and
- rear-mounted pop-up units, which have vent scoops that typically rise 8 inches from the rear of the unit to pull exhaust back and then down.

Both types are usually powered by strong fans. While neither unit performs as well as an overhead hood does for all heights of pots and all cooking loads, their relative strengths and weaknesses differ.

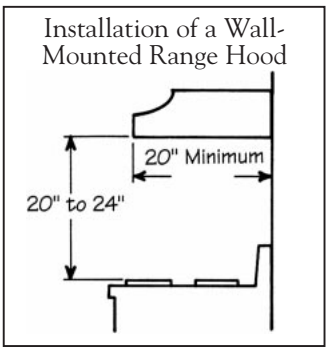
Counter-level units. Counter-level units, whether center- or side-mounted, successfully remove combustion gases, grease, and moisture from grills, pots, and pans shorter than 3 inches. But they capture very little rising from pans more than 3 inches high, such as spaghetti pots. If the household's cooking habits create considerable moisture from tall pots (do they cook a lot of pasta?), these hoods should be installed only if the kitchen is otherwise ventilated, such as by a whole-house system.

Rear-mounted units. Rear-mounted pop-up units, because their vents are located at roughly the height of typical tall pots (about 8 inches), perform well for pots on the rear burners. For the front burners, the capture rate for tall pots is poor, though that for pans under 3 inches is adequate with the fan on high.

This performance isn't ideal, but can be made to work. If a client wants a downdraft unit rather than an overhead hood, ask about cooking practices. If they use tall pots, your best bet is installing a rear-mounted pop-up unit capable of at least 400 cfm — and telling the client to cook the noodles and lobsters to the rear.

About High-Powered Fans

Island and downdraft models have two potential drawbacks you should watch for, both due to the high-powered fans these models use.



To maximize effectiveness, use a range hood that extends at least 20 inches from the rear wall, and install it between 20 and 24 inches over the rangetop. The hood should be the same width as the cooktop.

First, powerful fans are often loud when run at full speed. Most manufacturers list the sound level of their fans in *sones*. Unlike decibel ratings, sone ratings are linear: A sone rating of 4 means twice as much noise as a sone rating of 2.

The Home Ventilating Institute has set a limit of 9 sones for kitchen fans up to 500 cfm. (Refrigerators typically operate at about 1 sone.) A few range hoods operate at around 2.5 sones. Most fans, however, particularly downdraft and island hoods, range between 4 and 7 sones at full power.

Clearly, you're best off with the quieter fan, all other things being equal. Fans over 6 or 7 sones may not get used by the client. If the fan has a variable control rather than a simple two-speed switch, the clients can find a happy medium between low and high settings that is quiet enough to use and strong enough to adequately ventilate.

Getting a quiet fan will probably mean getting a centrifugal blower, sometimes called a "squirrel-cage" fan. The alternative, the prop-like axial fans, are generally noisy even at lower airflow rates. Fortunately, most quality exhaust fans are centrifugal models, since they better overcome the resistance caused by ductwork (see "Keep the Flow Going").

The other potential drawback to powerful fans is that in tight homes, they may create backdrafting. Backdrafting occurs when negative indoor pressure pulls combustion gases down natural-draft chimneys over furnaces, fireplaces, woodstoves, or water heaters (see "Backdrafting: Causes and Cures," 10/90). If you suspect that a backdrafting danger exists, you should test and if necessary provide some compensating fresh air intake before installing a powerful exhaust fan. ■

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