BY ALLISON BAILES

How to Size an ERV or HRV

When it comes to sizing an air conditioner, you've no doubt heard that it's a bad idea to install a system that has more capacity than the house needs. That's not true, however, when it comes to sizing an energy recovery ventilator (ERV) or heat recovery ventilator (HRV). Oversizing, in fact, can be a good thing. But we can't talk about oversizing an ERV (from here on out, I'm going to use "ERV" but it applies to HRVs, as well) without first having a reference point, a size above which the ERV might be considered oversized.

And before that, we have to talk about what "sizing" means in the context of ERVs. An ERV is one of many devices that ventilates by bringing outdoor air into a house. Because it has balanced supply and exhaust airflows and because it recovers heat (ERV and HRV) and moisture (ERV), it also happens to be the most efficient type of ventilation system for homes. When we talk about sizing any type of ventilation system, the relevant quantity is the airflow rate. That's it. How much air are you going to move through the system?

The two steps to sizing an ERV are deciding what you want the continuous ventilation rate to be and then deciding what size ERV you're going to get to provide that amount of ventilation.

VENTILATION RATES REQUIRED BY CODES AND STANDARDS

First, let's get units out of the way. In the U.S., we use cubic feet per minute (cfm) to specify airflow rates, but we can convert that into a number more meaningful for the size of the house being ventilated. When a ventilator moves an amount of air equal to the volume of the house, we say it has accomplished one air change. By factoring in the volume of the house, we can convert cubic feet per minute to air changes per hour (ACH).

The International Residential Code (IRC) ventilation requirements and the ASHRAE 62.2 residential ventilation standard are the two most common methods for setting ventilation rates in U.S. homes. Both use formulas based on the conditioned floor area of the house and the number of bedrooms. The IRC says you need 1 cfm for each 100 square feet of conditioned floor area plus 7.5 cfm per person, with the number of people defined as the number of bedrooms plus one. The current version of ASHRAE 62.2 uses the same format with one change: It uses 3 cfm per 100 square feet of floor area. ASHRAE 62.2 lets you take credit for infiltration and use a lower ventilation rate if the house gets a blower door test, but let's ignore that for this discussion. In tight houses, the ventilation credit is small, and I'm going to recommend going higher anyway.

PUTTING VENTILATION RATES INTO CONTEXT

Using those two formulas, we can calculate that a 3,000-square-foot house with three bedrooms would need 60 cfm under the IRC rule and 120 cfm using ASHRAE 62.2. Another way to look at the ventilation rate would be in terms of airflow per person. With the four hypothetical people in this house, the IRC calls for 15 cfm per person; ASHRAE 62.2 for 30 cfm per person. For reference, recommended ventilation rates have historically ranged from a low of 4 cfm to as much as 60 cfm per person.

A third way to characterize the ventilation rate is with air

Unlike a heating and cooling system, oversizing an ERV is not a problem, and even preferred. More ventilation is often better as long as it is balanced and recovers some heat and moisture.

Photo: Geoff Ferrell/Mandalay Homes

changes per hour. For a 3,000-square-foot, three-bedroom house that would need 60 cfm (IRC) or 120 cfm (ASHRAE 62.2), we can find the equivalent rates in air changes per hour. Assuming a 9-foot ceiling height, those ventilation rates would be 0.13 ACH (IRC) and 0.27 ACH (ASHRAE 62.2).

For our example house, we can find that the historical range of recommended ventilation rates is 0.04 ACH (4 cfm per person) to 0.53 ACH (60 cfm per person). The rate of 0.35 ACH is often mentioned in ventilation discussions as a minimum, and some ventilation designers use that as their go-to rate for continuous ventilation. On the high end, 0.5 ACH is about the limit of what's practical. These rates are summarized in the table below.

CHOOSE A VENTILATION RATE BASED ON COMMON SENSE

For most new homes, you need to follow local code or program certification requirements. Most of these requirements are considered minimums, so you can install more capacity. If you're putting an ERV into an existing home and aren't bound by any codes or program requirements, you can size it however you see fit. It makes sense, however, to size it so that it will be big enough to make a difference but not so big that you lose control of the indoor temperature and humidity. So, what's a reasonable rate to use?

The largest residential ERVs are rated at about 300 cfm or a bit more. As you can see from the table, a ventilation rate of 0.35 ACH would be 158 cfm for our example house. (I'm going to call that 160 cfm because trying to commission an ERV to ±1 cfm only leads to frustration.) It's higher than required by ASHRAE 62.2 and about half the capacity of a large ERV, two good reasons to go with this rate. (Of course, the size of the largest ERV isn't the limit. You can always install more than one unit.)

TWO REASONS TO OVERSIZE AN ERV

By looking at minimum requirements in codes and standards and available ERV capacities, we chose a continuous ventilation rate of 0.35 ACH, or 160 cfm, for our example house. Once we have an ERV that can give us the continuous ventilation we want, we can always turn it down if we decide it's too much. The good thing about turning it down is that fans are more efficient when they run at lower speed.

And that's reason number one to oversize an ERV. If you want to be able to supply 200 cfm of ventilation to the house, get an ERV that can move 300 cfm or more. What you don't want to do is get one rated at 200 cfm and run it at maximum capacity all the time. That's less efficient, and it interferes with reason number two.

Reason number two to choose an ERV larger than your continuous ventilation rate is so that you can boost it to a higher rate. If you're setting up the ERV to exhaust from bathrooms and a kitchen, you'll need one with a boost mode. Likewise, if you're having a party or have a sick person at home, boost gives you more fresh air when you need it. And that means you need an ERV with a capacity higher than your continuous ventilation rate. You can't boost when you're already running flat out on the highest speed.

Is it possible to overventilate a house? You certainly can cause humidity problems (too dry in winter, too humid in summer) with ventilation air. You can create comfort problems and high energy bills. You could even damage a house by sucking moisture into places where you don't want it, although the risk of that is drastically reduced with a balanced system that is neither negatively pressurizing nor positively pressurizing the indoor space. That's why you should use an ERV instead of using exhaust-only or supply-only ventilation. (Make sure to get one with high recovery efficiency and electronically commutated motors for the fans, too.) More fresh air is better for health. It reduces the effects of hay fever and asthma and reduces the concentrations of indoor pollutants. You don't want to skimp on indoor air quality, so don't skimp on the ventilation system.

EXAMPLE VENTILATION RATES

METHOD	CFM	CFM/PERSON	ACH
IRC	60	15	0.13
ASHRAE 62.2	120	30	0.27
60 cfm/person[1]	240	60	0.53
0.35 ACH[2]	158	39	0.35
0.5 ACH	225	56	0.5

1. At the high end of historical range, this rate was recommended in 1895 to reduce the spread of disease in buildings.
2. Limit established by the ASHRAE 62-1989 committee, which established 0.35 ACH but no less than 15 cfm/person as the appropriate minimum ventilation rate for dwellings.

This table shows a range of recommended ventilation rates for a 3,000-square-foot, three-bedroom house with a 9-foot ceiling height. The highlighted rates establish the way each is commonly cited. The last line establishes the upper range of what is practical to provide.

ADVICE FOR BUYING AN ERV

When you buy an ERV for a house, look for these features to get a unit that should serve you well:

- A maximum rate about twice as high as you plan to run it continuously.
- The capability of changing the rate so you can run it at a lower rate.
- The capability to boost to a higher rate when you need more ventilation.
- Electronically commutated motors.
- A core with a high recovery efficiency for heat (ERV and HRV) and moisture (ERV). The best units offer around 95% and 70%, respectively.

Make sure you look at the specifications of the models you're considering. There are plenty of low-cost, low-quality ERVs available.

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