Ask Jon Eakes

WHAT IS AN AIR-TO-AIR HEAT EXCHANGER, HRV and ERV?

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Air-change ventilation systems exist that take stale air out and bring fresh air in so as to not rely on cold air drafts for the entry of fresh air to the house. They are simply a box with two fans. In a few of the warm spots of Canada these are legitimate systems on their own. In most of Canada we have problems of distributing the very cold fresh air, and waste a lot of money throwing the hot air directly outdoors, so we have taken these air change systems a step further.

An air-to-air heat exchanger, or what is more commonly called today a Heat Recovery Ventilator (HRV), is a air change central ventilation system that exhausts stale air outdoors and brings in an equal quantity of fresh air to replace it while stealing the heat from the outgoing air to warm up the incoming air. See above for an animation on how that works. The air going out is more humid than the fresh winter air coming in, so it tends to dehumidify the house as well as remove most pollutants -- all of this with little or no pre-heating of the incoming cold fresh air. The HRV has been used in almost every energy efficient house since the early 1980's.

An Energy Recovery Ventilator (ERV) was developed about the same time with the specific difference that it returns about 50 percent of the humidity in the air back to the house in the winter but still sends all the pollutants in the stale air outdoors. This was especially interesting for houses with few occupants and the HRV tended to dry out the house too much. But precisely because it was returning humidity from one side to the other, in our cold weather the freeze/thaw of the core destroyed them quickly. For many years they were only used in the southern US in the air conditioning season -- bringing fresh air into the house but without half of its hot outdoor moisture. Returning moisture back to where it came from reduced the air conditioning load -- saving considerable energy in the summer. In the early 2000's Venmar finally developed a core that could stand up to Canadian winters and now the ERV has a legitimate place alongside the HRV throughout Canada and all year long. The ERV tends to cost a bit more than an HRV and it is not quite as energy efficient but it does in fact diminish if not elemenate the dry house problem.

In both HRVs and ERVs, the most energy efficient and quiet motors are ECM (Electronically Comunitated Motor) motors that ramp up slowly when they go on and at all speeds run using less electricity than regular motors. Their higher cost does have a payback. In the 90's these new motors were only available for high end condensing furnaces whereas today they are not always standard, but are commonly available. The difference in sound levels from a good standard motor to a good ECM motor is astounding.

In 2012 I changed my whole house quality HRV for a new technology Venmar EKO1.5 ERV and the noise and dryness problems are gone. The highest speed is quieter than the lowest speed of the old machine, a very important element for my wife.

Choosing between an HRV and an ERV

Although it would be good to consult a specialist to choose between these two, generally use an HRV in a large house with a lot of activity, use an ERV in a small house with little moisture producing activity. If air conditioning is important in your house, you will get an energy benefit from the ERV that you cannot get with the HRV. A few units on the market can actually change an HRV core for an ERV core rather than change the entire machine in case you change your mind, or the occupational habits of the house. That's the machine I put in my house because I like to be flexible and experiment. Click here for more details on the choice.

From a strictly cost payback point of view, the heat saved does not justify the capital and operating cost unless you have a fairly well-sealed house. In a poorly sealed house the system can even be detrimental, as it can over-dry an already dry house and further complicate the strange and variable

air currents in drafty old houses, possibly aggravating moisture problems inside the walls. As well, you are only recuperating heat from a small portion of the total house ventilation when most of the air change is happening with cold air drafts.
As soon as your house is reasonably sealed, however, you should consider installing an HRV or an ERV as the key to an energy-efficient and healthy house. I wouldn't build a new house without one although the codes only require air change units, not heat or energy recuperation units. They protect the house from moisture damage through proper ventilation and provide you with comfortable fresh air distributed throughout the house. In a very well sealed house, they become not only cost effective but almost mandatory for maintaining good air quality. It's kind of like watering the lawn; if the sky leaks a lot, the lawn sprinkler is useless and could even contribute to a flood. But the less rain, the more valuable the sprinkler -- and with no rain, the sprinkler becomes a necessity. Click here for more on To HRV-ERV or not to HRV-ERV.
Three core flow technologies
There are three basic types of domestic air-to-air heat exchangers on the market in Canada today: parallel plate cross flow design, parallel plate counter flow design, and the capillary wheel rotary design. (Some low quality central exhaust ventilation system companies that specialize in high pressure marketing have tacked on what is called a heat-pipe exchanger, two pipes, one inside the other. Commercial heat pipe exchangers exist, but the ones offered for homes appear to be more of a gimmick designed to fool the public into thinking that they will save significant energy with this system. I have seen no laboratory data that shows that a few feet of double ducting exchanges much heat.)
All the machines cost about the same at the present, if you are comparing for the same size and efficiency of heat recuperation. The best installation is with rigid ducting, not flex ducting -- it simply provides better air flow although it costs more in both material and labour.
With all of these machines, the slower the fan speed, the more efficiently they exchange the heat so they will be working their best at slow continuous speeds. ECM brushless motors provide the lowest operational cost for these continuous fans - and are the quietest. Because you must regularly remove and clean the core, insure that it is easily accessible. Installing these machines in the attic is plain stupid as no-one wants to go into the attic to clean the core (aside from the problem of everything freezing up). Of the parallel plate types, the counter-flow design (hot and cold air flow in opposite directions) is more efficient but much more difficult to design and maintain than the cross-flow design (hot and cold air flow at right angles to each other).
To truly compare the efficiency of these machines, at least of the best of them, ask for the HVI (Home Ventilating Institute) ratings. The HVI is an American outfit that now does all the ratings for the best of the fans for acceptance into the Canadian R-2000 and other energy efficient building programs. The HVI sticker is not an approval of any kind -- it is simply a credible third party assurance that the machine does what the manufacturer claims it does -- like real air flow and recuperation efficiencies.
To find the best installers, find one that is trained and certified to install for the R-2000 program, and ask that he test for balance of the final installed system as he would be required to do with an official R-2000 installation.
Whatever type you do get, insist on:
-- Continuous minimum operation of 100 to 200 cfm (higher speed humidistat or manual over-ride is a good idea).
-- Automatic defrosting.
-- Ease of cleaning.
The fresh air ducts:
-- can be run into the cold air plenum of your furnace if you have a forced air furnace (you must run the furnace fan on continuous mode), to bring the air up to room temperature and mix it with existing household air
-- or, if the fresh air is ducted directly into the rooms, the outlets must be high up on the wall and directed across the ceiling where the cold fresh air will mix with excess ceiling heat (my preference).
-- could serve as your furnace itself if you have a very well insulated house (low heating demand) by installing an electric plenum heater in the fresh-air distribution ducting (and electricity doesn't cost too

much in your area).
The stale air ducts:
-- should draw from high activity areas around the house.
-- should draw from bathrooms.
-- should not draw from the clothes dryers. For years we tried to filter this air so we could recuperate the heat, but it always ends up blocking up the system with lint. Duct clothes dryers directly outdoors.
-- should draw from kitchens but should not draw from range hoods as grease filters are just not good enough to keep the ducts clean. A non-venting filter hood over the range and an HRV stale-air grill on an opposing wall will keep the kitchen air fresh and the exchanger relatively grease-free. Many people install an ordinary range hood exhaust that shoots outside since it is rarely used anyway.
The best ventilation installation will have a fresh air input and/or an exhaust output in every room of the house -- leaving no rooms to sit with stale air.

Keywords:
Filters, Counter, Humidity, Installation, Moisture, Heat Recuperation, R-2000, Air Quality, HRV, Air Flow, Fresh Air, Furnace, Controls, Air Changer, ERV, Duct, Energy Conservation, Pollution, Forced Air, Fans, Video - Included, Bathroom, Drafts, System, Ventilation