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Inspecting heat recovery ventilators

by Bill Walker

Heat recovery ventilators (HRVs) are designed to provide either continuous or timed ventilation throughout a home and to recover the heat carried in the exhausted stale air. When installed correctly and operating under ideal conditions, HRVs can be more than 80 percent effective. Given Canada's cold winters and tightly constructed homes, homebuyers here welcome anything that promises to lower fuel bills and improve ventilation. Unfortunately few homes with HRVs provide anything near the ideal conditions necessary for the device to deliver as promised.

Because heat recovery and improved ventilation are invisible, homeowners and buyers may be equally unaware when a HRV is not performing as expected. Fortunately an informed home inspector can assess the situation by determining whether or not an HRV installation has the capacity to provide adequate fresh air or has any chance of achieving meaningful levels of heat recovery.

Inadequate ventilation

The first step in understanding why HRVs under perform in most homes is learning about the ventilation features found in a home designed to maximize HRV benefits. In a Canadian home built to the R-2000 Energy Efficient Home Program, there is the capacity to provide continuous fresh air to every room in the house, and to exhaust polluted air from the kitchen, bathroom(s) and laundry room. Switches in the kitchen and bathrooms make it possible to boost the HRV into high speed, taking the place of separate kitchen and bathroom exhaust fans.

In this home, the exhausting air has its own duct system. Ducts connect and pass through a heat exchanger in the HRV. In the winter the heat exchanger uses the exhausting air to preheat the incoming air. This heat recovery saves energy, and allows the incoming cold, fresh air to be usable without the need for a heater in the supply ducts.

The HRV is designed to deliver the fresh air to the furnace. With modifications, the furnace's warm air supply ducts can be used to deliver the fresh air to each room. From the furnace the fresh air is circulated continuously using the furnace fan, on low speed.

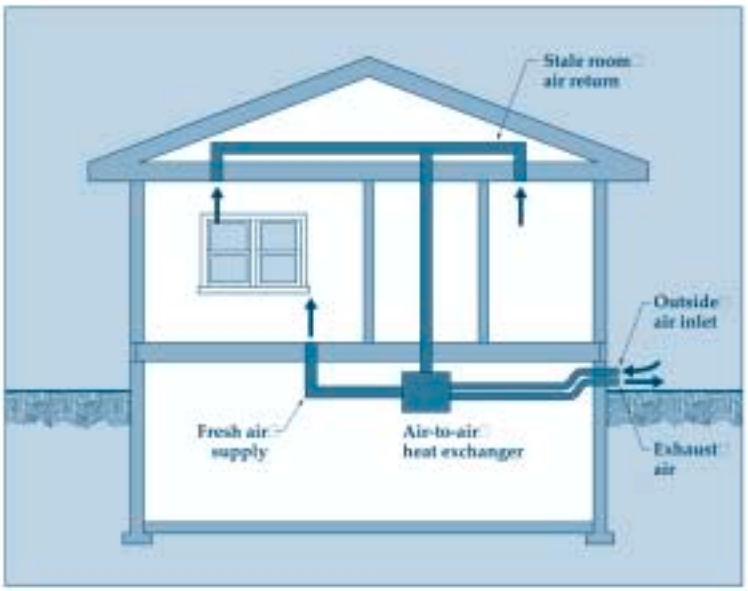
Position of supply registers crucial

During the heating season, the preheated fresh air can only be delivered continuously through the heating ducts by locating the supply registers on the wall, at least six feet above the floor. When the supply registers are on the floor, the continuous cool fresh air from the HRV creates uncomfortable drafts. If the supply registers are high on the wall, the cool ventilation air mixes with the warm air near the ceiling, settling into the room - minimizing drafts.

It is not possible in cold climate winters to provide continuous ventilation using typical floor mounted warm air ducts. To illustrate the significance of this problem, consider all forced air furnace fans are controlled with a high-limit switch. A fan-limit switch is programmed to turn the furnace fan on only after air inside the furnace heats up by 20 degrees. This is done to prevent room temperature air blowing out of the floor registers, creating cold drafts with the cooling effect of a summer fan.

Ventilation contractors solve the cold draft problem at floor registers by delaying the circulation of cold fresh air until the furnace is running. The incoming cold, heavy air is directed into the furnace and trapped, like cold air in a top-loading freezer at the supermarket. The downfall with this design is it does not deliver fresh air continuously. Ironically, with this strategy every future gain in furnace efficiency, improvement in insulation, upgrading of windows or installation of better weather stripping reduces the length of time the furnace runs. Consequently as more ventilation is needed, less is delivered, and the homeowner is none the wiser.

Lack of ventilation is an even more significant problem in the spring, summer and fall - when the furnace is not running, but the HRV is on. The homeowner thinks it is ventilating the home. In fact HRV fans are only sized and balanced to deliver the fresh air into the furnace. If the furnace fan is not running continuously, there is minimal or no fresh air entering the rooms due to resistance in the supply ducts.



Heat recovery ventilation

Efficient heat recovery

To achieve useful levels of heat recovery it is necessary to have balanced airflows in the HRV's heat exchanger. As the incoming and exhausting air streams pass each other the temperatures equalize. More than 80 percent heat recovery is possible under ideal conditions. The efficiency of heat transfer drops dramatically when the two air streams travel at different speeds. The need to maintain balanced airflows in the heat exchanger has become the Achilles' heel of HRV installations.

For example, in the coldest weather the warm exhausting air inside the HRV cools and forms condensation, then frost, blocking the airflow. To solve this, HRV designers have installed temperature sensors in the air stream and motorized dampers programmed to shut off the cold intake and circulate the warm air through the heat ex-changer, providing an automatic defrost. This works, but inevitably reduces the efficiency of the HRV in the coldest weather, when heat recovery is needed most.

Unfortunately not all problems that create unbalanced airflows are within the control of HRV designers. The majority of features that reduce the efficiency of an HRV are built into the home. The R-2000 technical standards work with HRV engineers eliminating all significant sources of mechanical depressurization that would interfere with the HRV. Almost all other homes are full of mechanical equipment or exhaust fans that wreck the efficiency of the HRV.

Features built into a home that affect the efficiency of an HRV include the following:

- Non-sealed combustion appliances including furnaces, hot water tanks and gas fireplaces
- Exhaust fans including kitchen, bathroom, sauna, recreation room and central vacuums that exhaust

to the outdoors

• The majority of wood burning fireplaces unless they are an airtight design with an exterior source of combustion air

• Dirty heat exchangers, air filters or air intake in the HRV and the furnace air filters

• Any renovation that changes the air resistance in the heating and ventilation ducts

Operation items also affect the efficiency of the HRV

• An open second story window in the winter can have air rushing out due to stack effect, and the "make up air" will flow in the HRV changing the balance of airflow

• Balancing supply ducts from summer to winter between heating and air conditioning seasons

• Carpets, furniture, futons, built-ins shelves or captain's beds etc. covering supply or return air ducts.

Any one of the above features or combinations of neglectful maintenance and/or inappropriate operation will accumulatively reduce the heat recovery of the HRV and yet the impact is invisible.

Building tight and ventilating right

Successfully building tight and ventilating right is an all or nothing strategy. Building tight and not ventilating right results in invisible problems that are subtle to detect and easily misunderstood.

Though determining the effectiveness or adequacy of a mechanical system is beyond the scope of the ASHI Standards of Practice (2001 SOP, 13.2, B3) to be effective as consumer advocates when inspecting a home with HRV, home inspectors need to determine where the heat and ventilation supply registers are located. If the supply registers are on the floor, the inspector should inform the customer the system will not comfortably supply continuous fresh air during the heating season unless there is an inline heater in the supply ducts.

Inspectors also need to determine if mechanical equipment is sealed combustion or if it will depressurize the home and inform the customer of the impact the findings have on heat recovery in the HRV.

Finally, the inspector needs to take inventory of all the exhaust fans in the home and explain how each exhaust fan reduces the efficiency of the HRV. It is desirable during construction (albeit often not practical) to incorporate all exhaust fans into the HRV, using the potential of the HRV instead of reducing its efficiency.

Bottom line

When applying the above criteria, most homes are not logical candidates to have an HRV and few homes with HRVs are capable of providing continuous ventilation or useful levels of heat recovery. ■

Bill Walker was a registered home inspector in Canada, an ASHI Member from 1992 to 1997 and a licensed design evaluator for the Canadian R-2000 Energy Efficient Home Program. During his 20 years of experience with energy efficient construction and ventilation systems, he worked on energy efficient renovations and new home construction. To qualify as an R-2000 design evaluator, he trained with the Heating, Refrigeration & Air Conditioning Institute (HRAI), as an HRV duct designer and HRV installer. He also worked as a mechanical draftsman designing commercial ductwork. His training and inspection experience in cold climates qualifies him to address what he believes to be a widespread lack of understanding among home inspectors as to how to inspect and evaluate HRV installations. Walker is available for training seminars on the topic. He can be contacted at bwalker@tbaytel.net.

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