BetterBuilt NW

Heat Recovery Ventilation System Design Considerations

Stand-alone systems for demonstration purposes

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Questions?

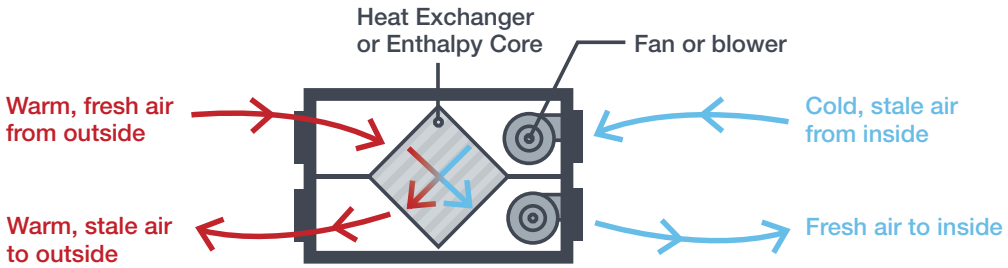
info@betterbuiltnw.com

Definitions and Introduction

Key Terms

HRV: heat recovery ventilator/ventilation system
CFM: cubic feet per minute
ERV: energy recovery ventilator/ventilation system
Vent: intake or exhaust from the HRV to exterior
SRE: sensible recovery efficiency
Register/Grill: termination inside a room
ASRE: adjusted sensible recovery efficiency
IMC: International Mechanical Code
Heat Exchanger: device that allows for heat transfer without mixing air or fluid

Achieving reliable ventilation effectiveness in relatively tight homes requires a balanced system. While there are multiple ways to achieve balanced ventilation strategies in residential new construction, Heat recovery ventilators, or HRVs, are the optimal home balanced ventilation system for tight homes in the Northwest. Energy recovery ventilators, or ERVs, may be better suited for cold climates and higher elevations. Read below for tips and recommendations to make the most of your HRV installation, because unless properly designed, installed and operated, an HRV may be no more energy efficient than a pair of exhaust fans.



Heat recovery ventilator (HRV) airflow

Please note: *This guidance only applies to stand-alone HRVs only. HRVs integrated with centrally ducted heating and cooling systems may have additional design and installation requirements.*

We have broken these recommended practices into four distinct steps, with extra emphasis on system specification and efficiency.

Step 1. Planning

System Design Considerations and Layouts

If located in the same room, supply air should be delivered on the opposite side of the room from the entry door or exhaust air.

HRV supply and exhaust air vents should be >10 ft. apart. Never install vents on a roof.

System filters and core must be easily accessible for maintenance.

Ensure proper condensate drainage. Consider the usefulness of gravity for drainage purposes.

Install exhausts in bathrooms, supplies in bedrooms, and both in the main living area.

If the system recirculates air for defrost, position the defrost air ducts to draw from conditioned space.

Consider installing supply registers/grills in closets and corners of rooms to prevent direct airflow on occupants.

Situate unit in a tempered or conditioned space (but never in an attic or crawlspace).

System Layout Examples

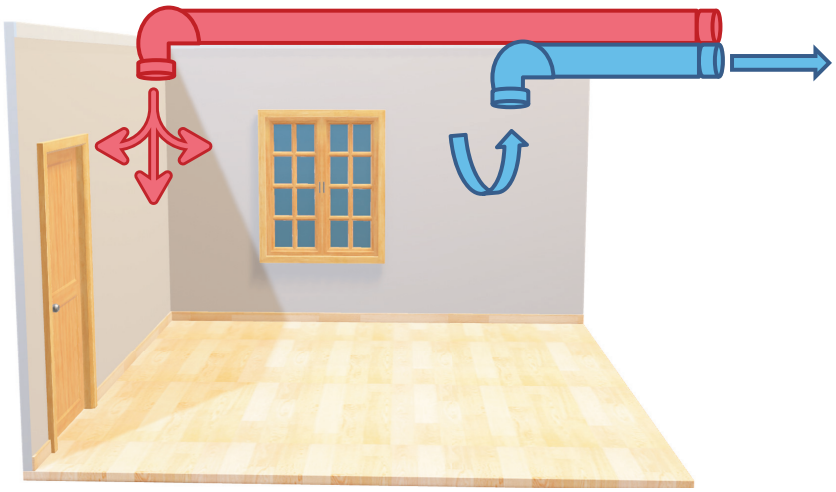
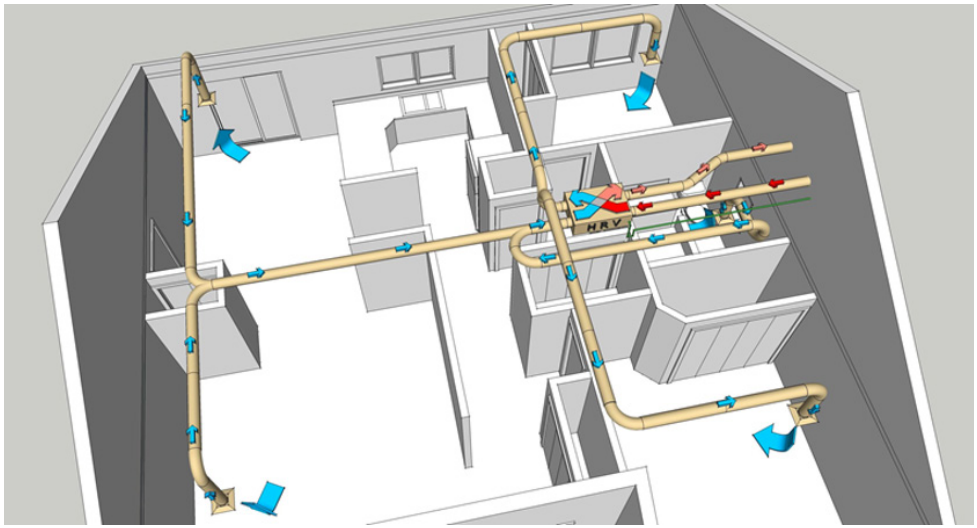


Diagram of supply air entering room on opposite side from where air is exhausted



Plan view for stand-alone HRV or ERV (Courtesy Homes.lbl.gov)

Step 2. Size & Efficiency Considerations

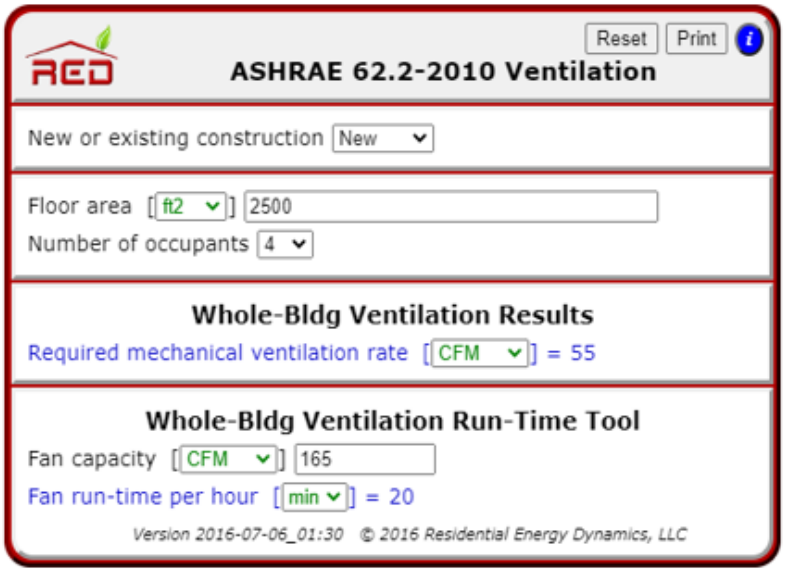
Continuous Ventilation (Right Sized)

Ensure HRV is capable of delivering airflow (recommended at a medium-range speed setting) at the following rates: (sq. ft. x 0.01) + [(# of bedrooms + 1) x 7.5] and ensure that each ¾ or full bathroom is receiving continuous ventilation.

When determining the CFM requirements for an HRV, you must be able to meet 2018 International Mechanical Code (or other applicable standards) for whole-house ventilation requirements at medium-range speed.

Note: Installing local exhaust is still recommended in ¾ and full baths. In new construction, local exhaust is not factored into meeting the whole house ventilation requirements.

Help in sizing can be found at:
https://www.redcalc.com/ashrae-62-2-2010/



Intermittent Ventilation (Super Sized)

Ensure HRV can deliver airflow at the continuous rate (recommended at a medium-range speed setting—see above). Recommended intermittent settings are:

- For 20 min. of ventilation and 40 min. of recirculation, use: {(sq. ft. x 0.01) + [(# of bedrooms + 1) x 7.5]} x **3**
- For 40 min. of ventilation and 20 min. of recirculation, use: {(sq. ft. x 0.01) + [(# of bedrooms + 1) x 7.5]} x **1.5**
- Minimum run time for intermittent ventilation should be checked with your local authority having jurisdiction but is most often 15 minutes per hour.

Step 2. Size & Efficiency Considerations

Efficiency Considerations

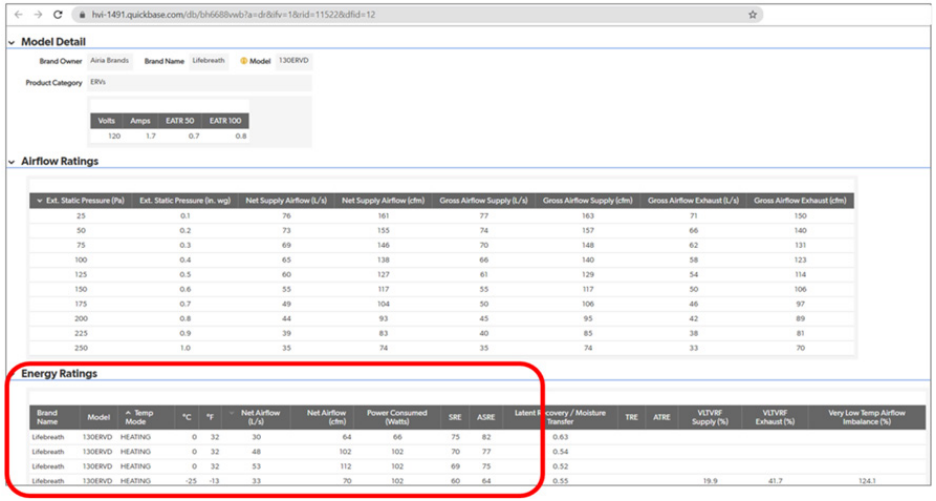
Look for units with the highest/best SRE, ASRE, and fan efficacy in your price range.

SRE > 75 Percent = High Efficiency

High SRE keeps operating costs low. The SRE indicates how efficient an HRV is at capturing heat transfer between the incoming and outgoing air streams. SRE lower than 75% will increase energy consumption.

ASRE > 75%. ASRE, is intended to be utilized where the energy modeling software accounts for HRV fan energy as a separate input.

Make sure that the fan flow, SRE, and ASRE are selected from AHRI energy rating data at 32°F for the speed that most closely matches the homes needs.



High Efficacy = Low Energy Costs for Homeowners

The fan efficacy indicates the amount of air that can be moved per unit of energy used. Efficacy lower than 1.25 CFM/watt may still transfer heat from airstreams efficiently, but risks using higher fan energy.

Example House

2000 sq ft home with 3 bedrooms: **60 CFM**

System rated for **64 CFM at 32°F utilizes 66 watts**

Fan efficacy is **66 CFM / 64 watt or 1.03 CFM/watt**

Step 3. Installation

Duct Layout and Installation Considerations

- Install ductwork INSIDE the Building Thermal Envelope, including all supply and exhaust ducts between the HRV and the home. If installation inside the Building Thermal Envelope is not possible, properly seal and deeply bury ductwork in insulation.

  The unit must be able to deliver the calculated requirements at medium-range speed setting at a static pressure of no greater than 0.4 inches of water column (IWC). Never design systems for continuous high-speed operation, instead, design systems to meet whole house ventilation requirements at medium speed, running continuously. This allows for “boost” functionality during times of high occupancy or particularly troublesome indoor pollutant creation.

- If recommended by the manufacturer, install balancing dampers on the HRV.

- If using a packaged HRV and duct system, use the manufacturer guidelines for duct sizing. If using an HRV and standard ducts, size ducts to table below:

Maximum Airflow (CFM)	Sheet Metal Duct Size (inches)	Flex Duct Size (inches)
30	4	5
50	4	5
75	5	6
110	6	7
175	7	8
325	9	10

Install high-quality duct fittings with fewest possible 90-degree turns.

Install elbows on all boots.

Install flex with 5 percent maximum compression. Seal and insulate all ducts.

Step 4. Testing & Commissioning

Balance system to manufacturer's specs

System imbalance lowers efficiency and may negatively affect delivered air temperature.

Measure airflow for exhaust and supply registers against design values

Note: You may need different tools for low volume air flow measurements.

Program HRV controller to meet your state's version of the International Mechanical Code

Particularly when using an efficient and high efficacy HRV, there is little harm in increasing ventilation to above the IMC requirements.

Educate Homeowner

Always provide the manufacturer's HRV system operations and maintenance manual and consider providing a customized ventilation manual.

Continue Learning

BetterBuiltNW

BetterBuiltNW has several resources and trainings on balanced ventilation*

https://training.betterbuiltnw.com/learn/course/internal/view/elearning/366/2018-wsec-r-balanced-ventilation-with-hrvs-ervs

Home Ventilating Institute (HVI)

Home Ventilating Institute (HVI) provides guidance and a product directory for ventilation equipment.

https://www.hvi.org/hvi-certified-products-directory/

Building America Solution Center

The Building America Solution Center provides guidance, training, images, and case studies on a variety of code and above code measures.

https://basc.pnnl.gov/resource-guides/whole-house-ventilation-strategies-new-homes

Heating Refrigeration and Air Conditioning Institute of Canada (HRAI)

The Heating Refrigeration and Air Conditioning Institute of Canada (HRAI) provides terrific guides and trainings around ventilation.

https://www.hrai.ca/technical-manuals

**Requires registering for online training modules*