

The background of the slide is a photograph of a building's wooden roof truss system, showing various wooden beams and rafters against a clear blue sky. A dark blue rectangular box is overlaid on the center of the image, containing the title and subtitle text.

Making Friends and Influencing Physics: HRVs and Central Air Handler Integration

RESNET 2017

Housekeeping

Welcome

- Safety
- Bathrooms
- Cell phones

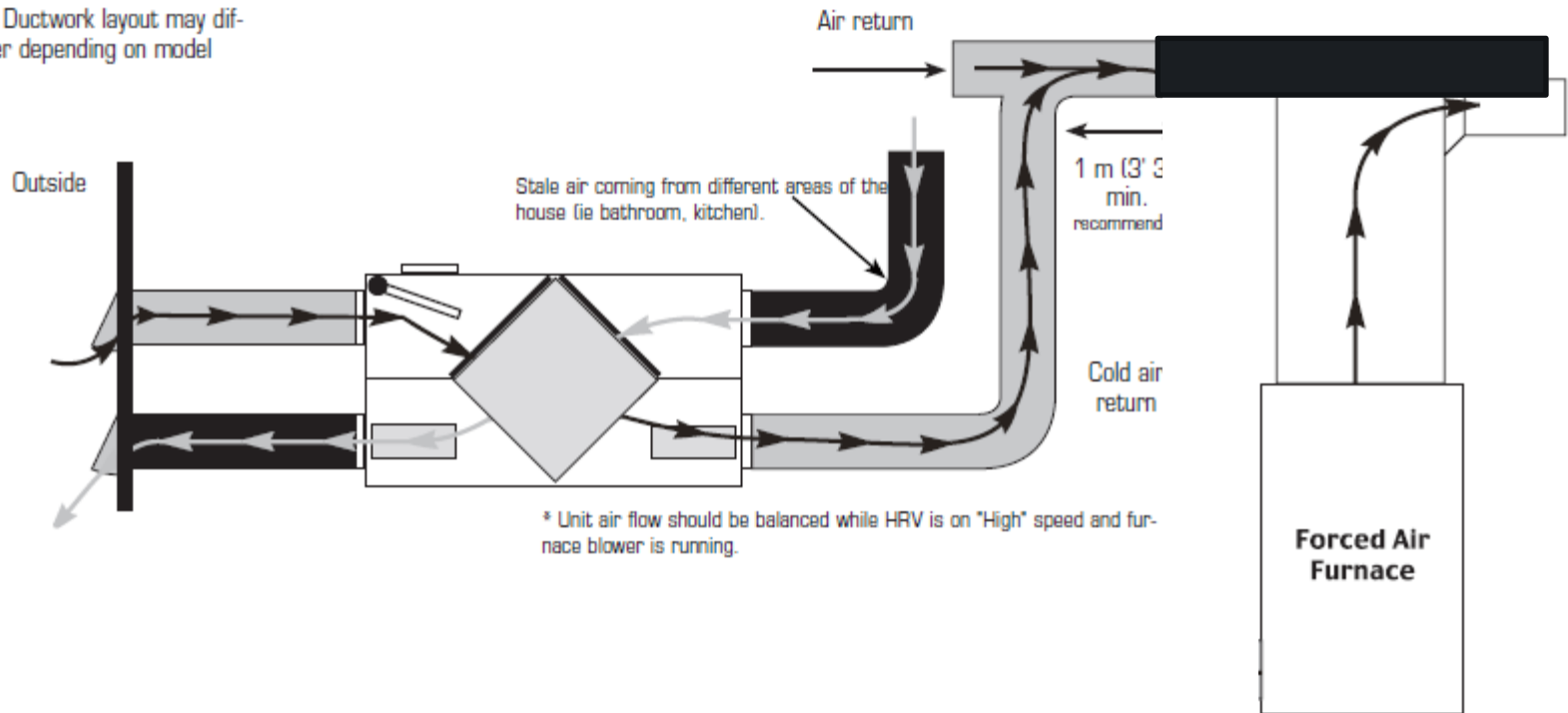


Oh sweet baby Marcus, what are these guys talking about influencing physics?

Stale air from house; fresh air to return

HRV/Furnace ducting for Partially Dedicated System

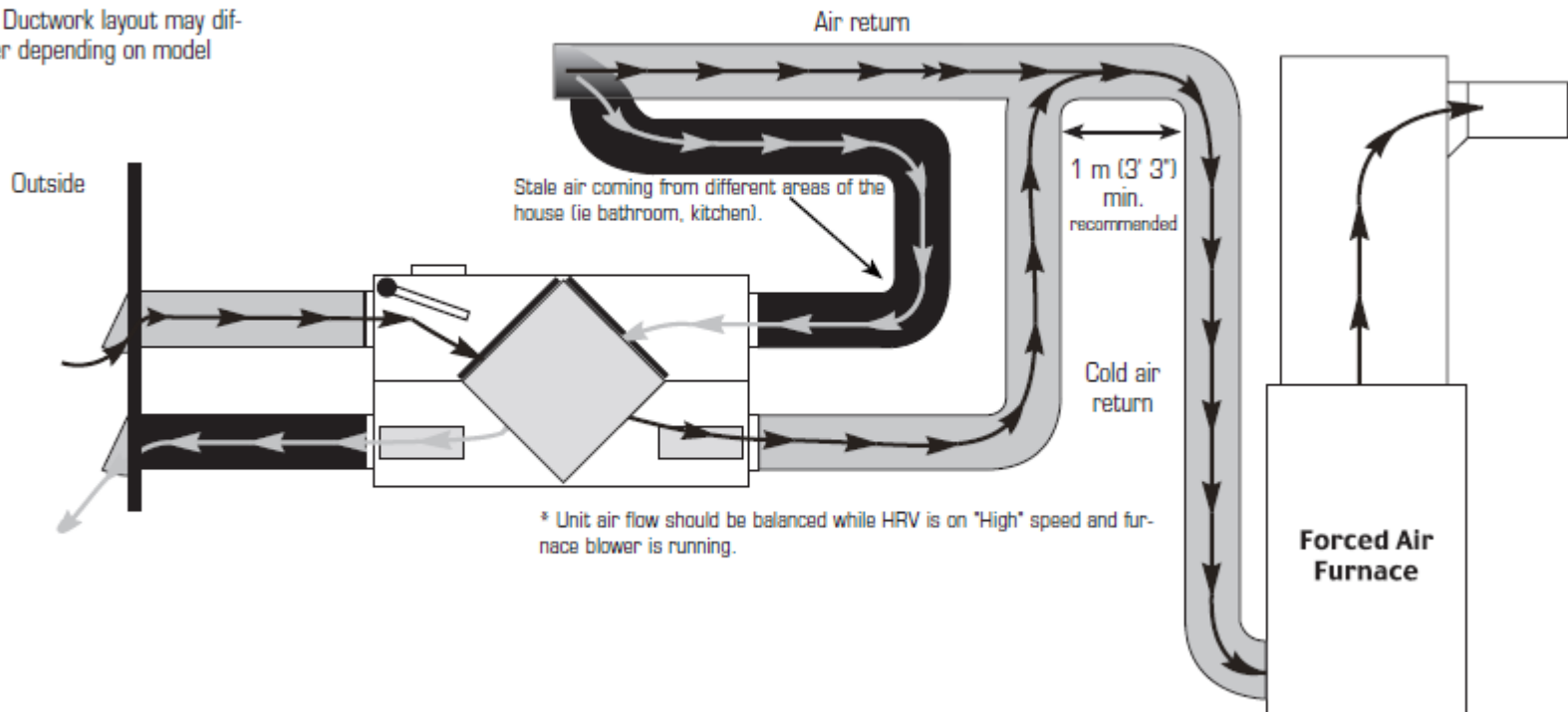
* Ductwork layout may differ depending on model



Stale air from return; fresh air to return

HRV/Furnace ducting for Simplified Installation - Option 1

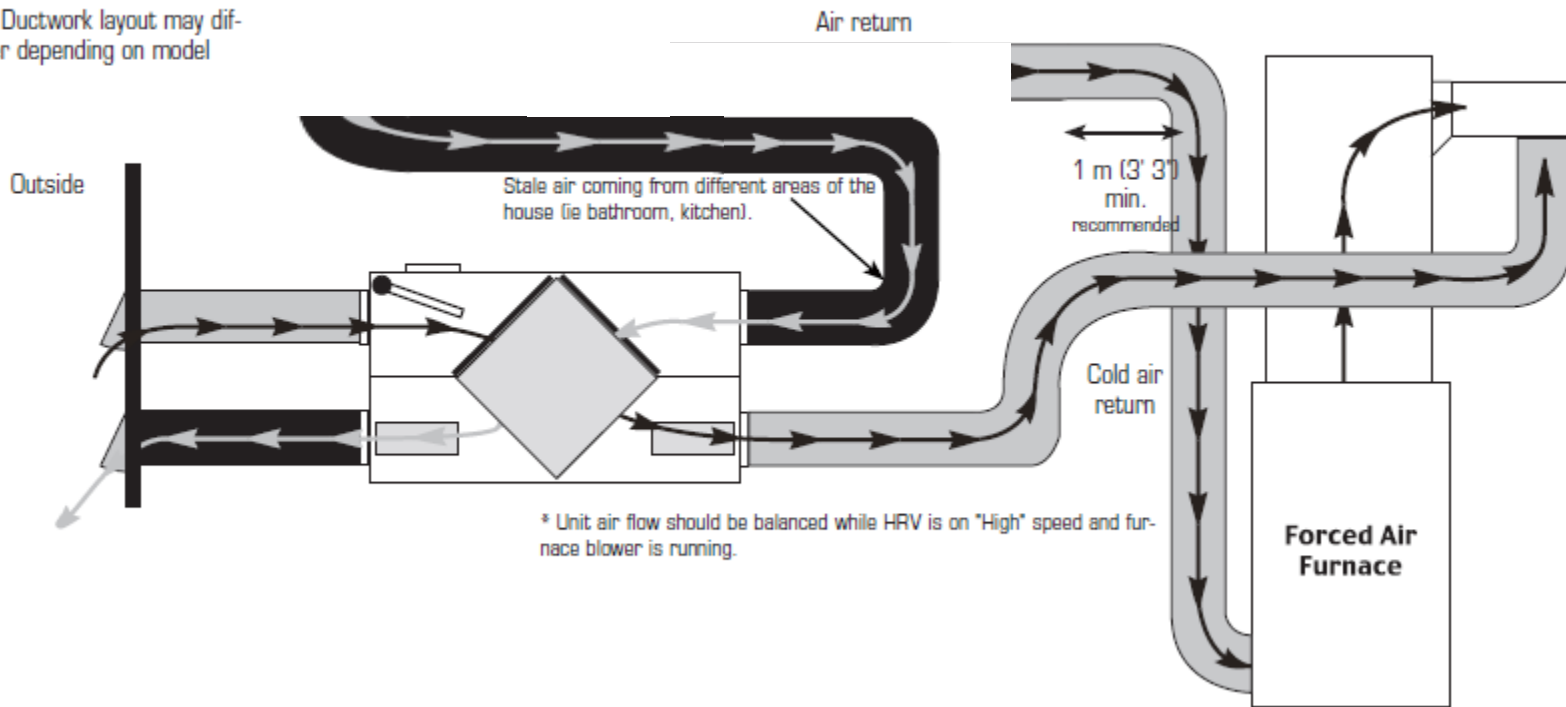
* Ductwork layout may differ depending on model



Stale air from house; fresh air to supply

HRV/Furnace ducting for Simplified Installation - Option 2

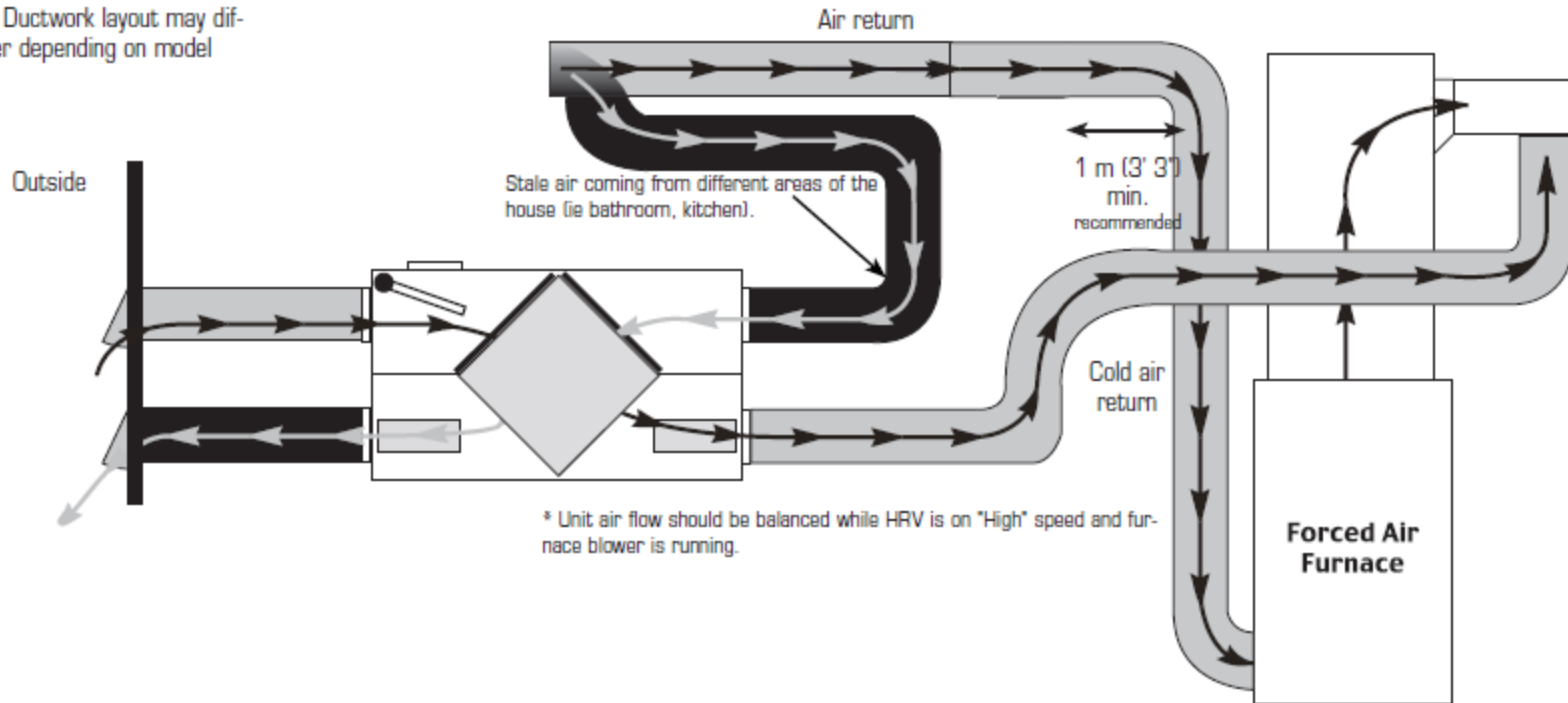
* Ductwork layout may differ depending on model



Stale air from return; fresh to supply

HRV/Furnace ducting for Simplified Installation - Option 2

* Ductwork layout may differ depending on model



A photograph of two construction workers on a building site. The worker on the left is wearing a white hard hat and a light blue shirt, pointing towards the wooden framing of a building. The worker on the right is wearing a blue shirt and jeans, holding a hammer and a tool bag. The background shows the wooden skeleton of a building under construction against a clear blue sky. A dark grey rectangular box with white text is overlaid on the image, and an orange square is partially visible behind it.

HRV Value Proposition

Learning Objectives



After this training, you will be able to...

- 1. Explain the value of adding an integrated HRV to a building**
2. Identify the rationale behind the integrated injection HRV efficiency spec
3. Find resources to support the installation of integrated HRVs

Successful Marketing

Y'all, what are some of the features and benefits you're selling today?

Successful Marketing

Marketing ventilation and health is not new



Bad Air vs. Good Work

You can't do your best work—and you shouldn't expect it of others—in a stuffy, perhaps smoke-filled room, breathing the same air that has been breathed over and over by several people. Pure air is just as necessary as pure food. Poor ventilation produces not only discomfort and loss of energy, but greater susceptibility to disease.

The only way to get fresh air indoors at reasonable cost is to use a

STURTEVANT
Ready-to-Run Ventilating Set

6 The Literary Digest for November 2, 1929



"ARE THEY COMING TO LIVE WITH YOU AGAIN THIS WINTER?"

CANE-FIBRE INSULATION

means protection from the ills and discomforts of cold weather . . . plus smaller fuel bills

of an inch thick, also made "double thick"—7/8 inch, is especially designed to reinforce against plaster cracks and eliminate lath marks.

Before you build, buy or remodel, ask your architect, builder or dealer for further information on Celotex—and write us for our free booklet, "Year

. . . So plan now to repair or remodel your home with Celotex, the only cane-fibre insulation.

inch thick, also made "double thick"—7/8 inch.

And they contain millions of tiny

Marketing HRV to homeowners

Avoid jargon

- Parts per million
- ACH
- ASHRAE 62.2

Homeowners don't immediately recognize the value of HRVs

Emphasize

- Fresh
- Filtered
- Healthy
- Comfort... everywhere!

Marketing Green

1. Educate sales team
2. Design still matters
3. Flyers in home, in plain English
4. Signage
5. MLS remarks
6. Brokerage outreach
7. Invest in staging—especially at higher end

“One couple was really into the technology...”

REDFIN LISTING AGENT

Ruby Manuel


4.7 ★★★★★ 111 Reviews

With Redfin since 2010

Homes Sold: 138

Ruby's Neighborhoods: Ballard, Northwest Seattle, Green Lake, Phinney Ridge, Fremont, Wallingford, Magnolia-Queen Anne, Northeast Seattle, North Seattle

 (206) 800-7167

 Currently taking calls



Benefits of HRV to Homeowner

Continuously Distributed Fresh Air

- Fresh air throughout the home, not simply in one zone
- Provides optimal ventilation for a healthier indoor air environment

Energy Efficient

- An **energy-efficient** fresh air solution for your **energy-efficient** home
- **Quality** fresh air solution for a **quality** home

Benefits of HRV to Builder

Product Differentiation

- A unique and tangible feature
- Conveys your concern about the homebuyer's health and well being, and your attention to detail and knowledge of building science.

Helps Meets Current and Future Code

- Actually brings the V back into an HVAC total system

Benefits of Integrated HRV

Benefits for builders

- Utilizes existing HVAC ductwork
- Least additional ductwork to be installed
- Saves cost
- Already going to all the rooms that need fresh air

Benefits for homeowners

- More comfortable air

Success Stories

“At one of my recent training sessions for our sales staff, on the topic of 'selling high performance homes', the whole team agreed that the HRV was a great tool to use when selling the features of the homes”.



A photograph of two construction workers on a building site. The worker on the left is wearing a white hard hat, a light green shirt, and dark pants, pointing towards the wooden frame of a building. The worker on the right is wearing a blue shirt, blue jeans, and a tan tool belt, looking at the worker on the left. The background shows the wooden skeleton of a building under construction against a clear blue sky. An orange square is positioned to the left of the text box.

Ventilation Systems

Learning Objectives



After this training, you will be able to...

1. Explain the value of adding an integrated HRV to a building
2. **Identify the rationale behind the integrated injection HRV efficiency spec**
3. Find resources to support the installation of integrated HRVs

Ventilation System Types

1. Exhaust Only
2. Supply Only
3. Balanced – Stand Alone
4. Balanced – Furnace Integrated



A leaky house is not a ventilation system

Why Don't People Install HRVs?

- We mistake ventilation as an energy thing, not an indoor air quality (IAQ) thing
- Little or no benefit in REM/Rate*
- Too expensive
- Not the best choice for all homes



* unless you really understand how to model all of the features individually

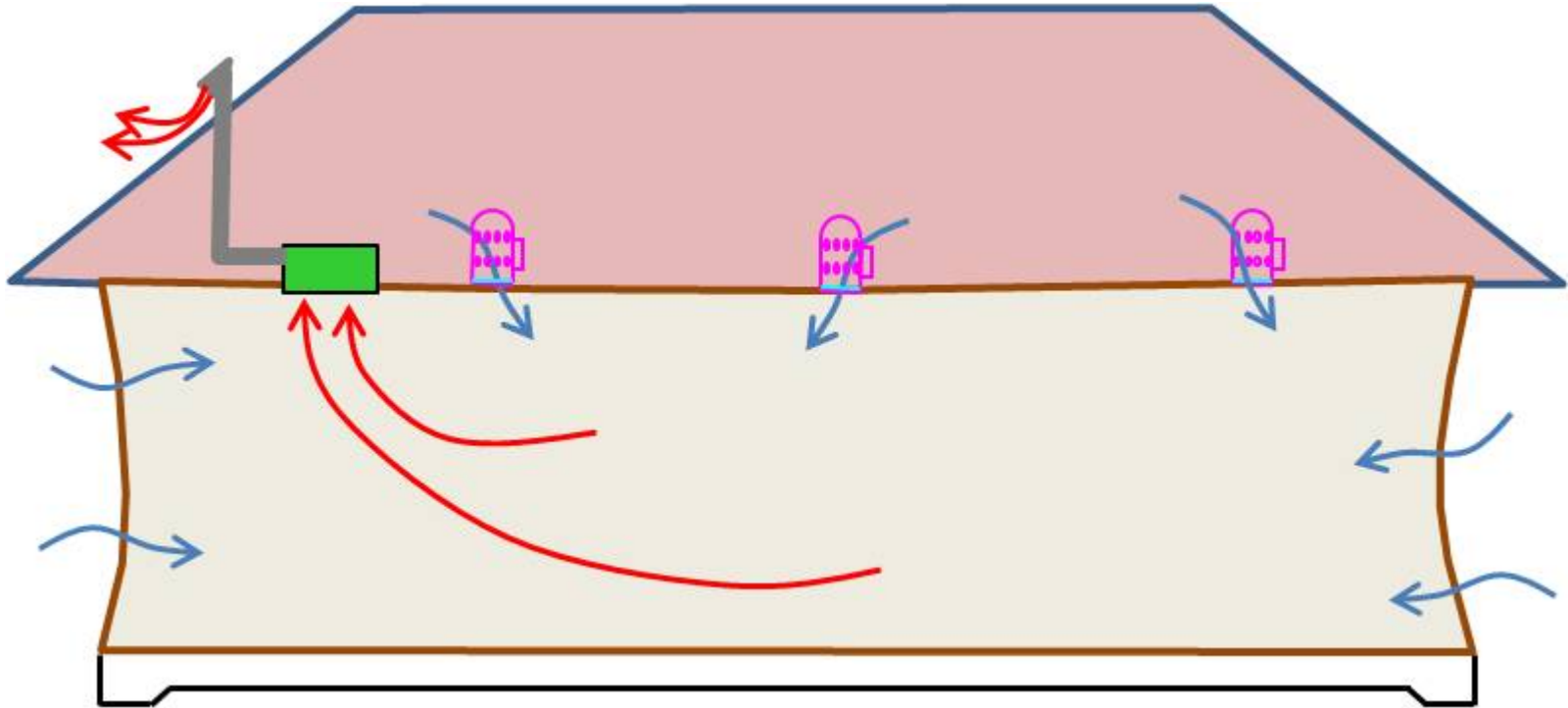
Mechanical Ventilation

An ideal ventilation system

- Homeowners understand it
- Homeowners use it
 - They don't turn it off because it makes the home uncomfortable
- Doesn't use too much energy



Exhaust Only



Dedicated fan(s) remove air from one or more locations

Exhaust Only

Advantages

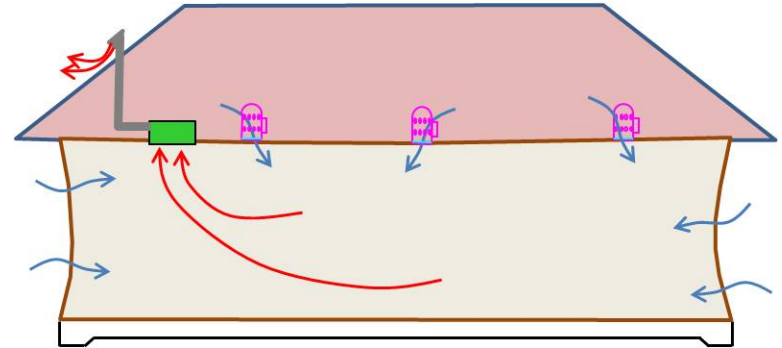
- Inexpensive

Disadvantages

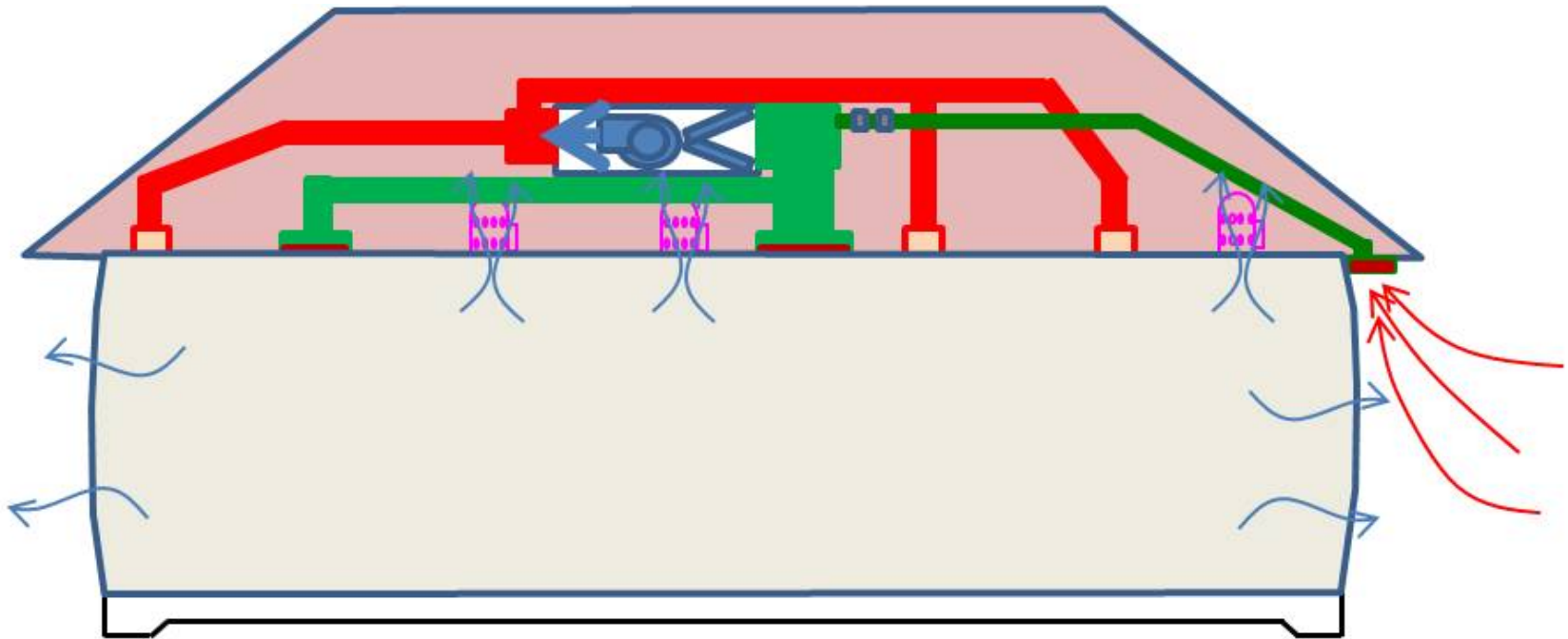
- Lowest probability of providing adequate ventilation
- May add to energy consumption of home
- Needs controls to properly integrate with central furnace
- Not balanced
- Not filtered
- Not distributed

Best Application

- 5.0+ ACH₅₀ homes (if exhaust fan efficiency is > 4.0 cfm/Watt)



Supply Only (~~hole in the return~~)



Outdoor air injected into the return air plenum

Supply Only

Advantages

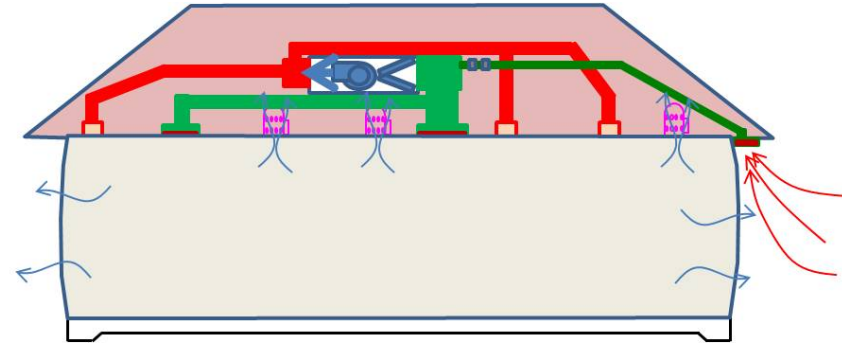
- Inexpensive
- Good air distribution

Disadvantages

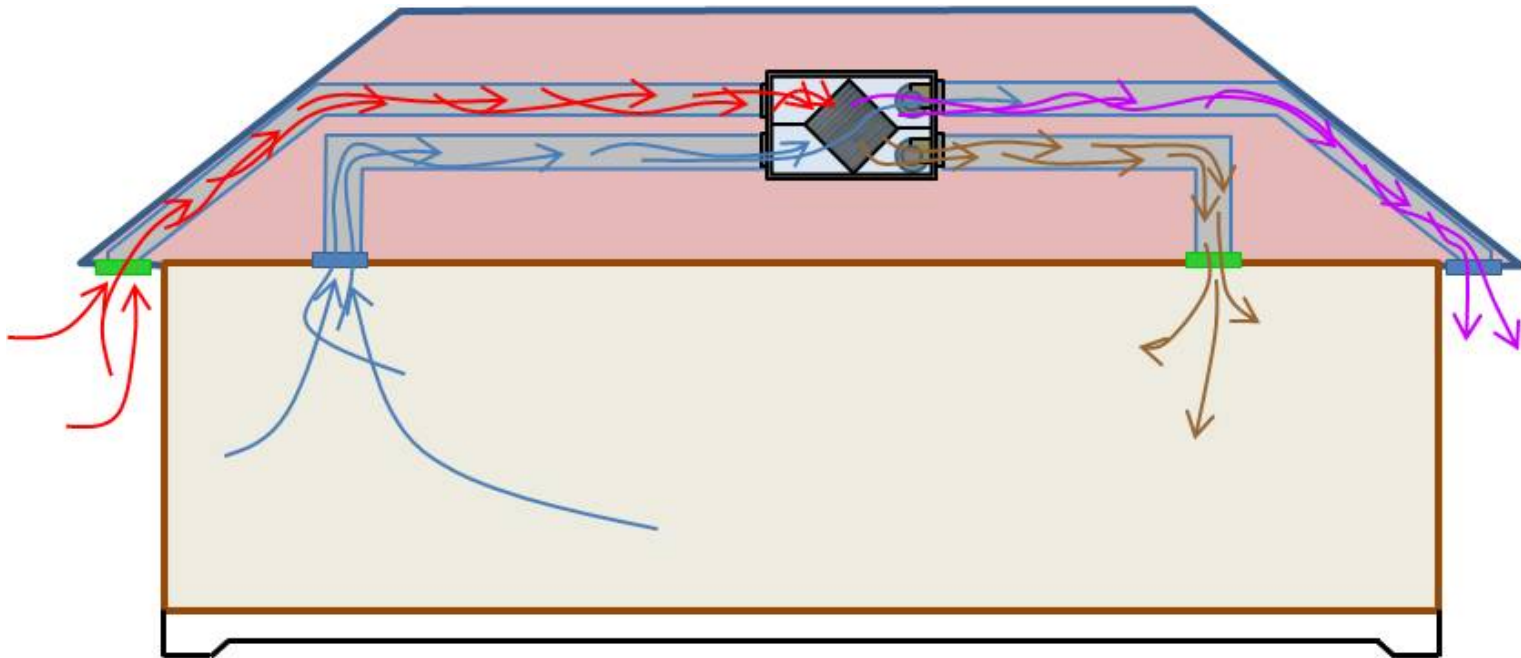
- Adds hole in the return-half of the system that might not seal when not used
- Complexity of both damper and fan controls may make system work poorly
- Positively pressurizes home and may push pollutants/moisture into cavities
- Outside air reduces the heating and cooling capacity of the system
- Only when furnace/heat pump air handler is running
- May have comfort issues
- May use higher energy AH fan

Best Application

- Almost Never



Balanced – Standalone HRV

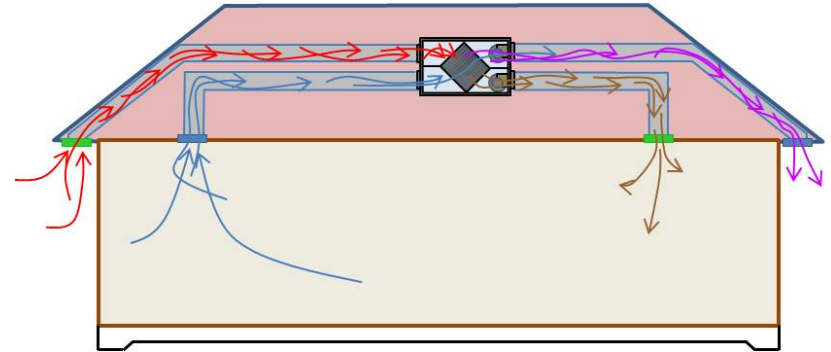


HRV with dedicated supply and return ducts to main living areas

Balanced – Standalone HRV

Advantages

- Balanced ventilation
- Best air distribution
- Potentially saves energy (with good fan)
- Pulls EXHAUST air from bathrooms and other high moisture or pollutant areas



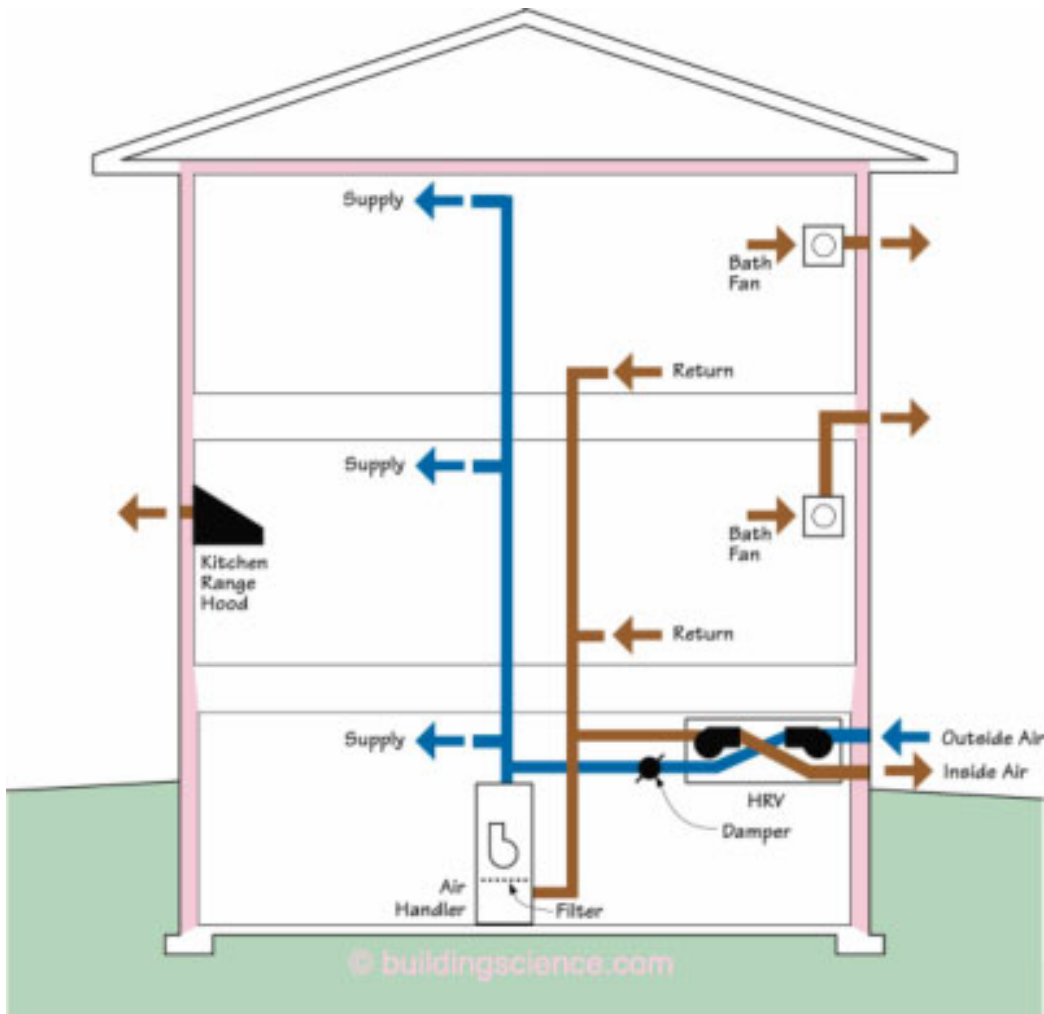
Disadvantages

- Increased cost compared to code minimum requirements
- Requires running ducting independent of other systems into rooms*
- Fresh air must be delivered into main body rooms and bedrooms
- System must be commissioned and balanced

Best Application

- DHP and radiantly heated homes

Balanced – Integrated HRV



Balanced – Integrated HRV

Advantages

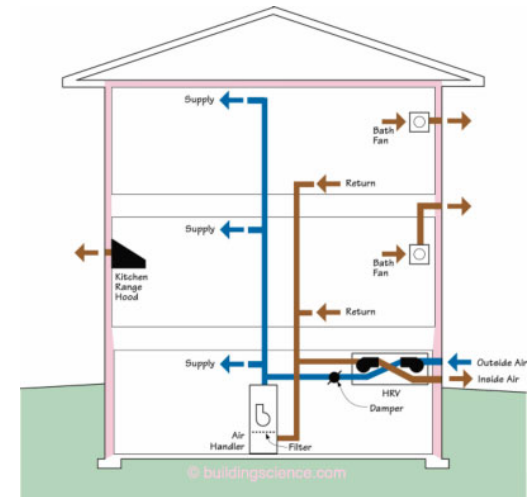
- Balanced ventilation
- Best air distribution
- Potentially saves energy (with good fan)
- Pull EXHAUST air from bathrooms and other high moisture or pollutant areas

Disadvantages

- Costs more than code minimum requires
- Requires running ducting independent of other systems into rooms
- Fresh air must be delivered into main body rooms and bedrooms
- System must be commissioned and balanced

Best Application

- Airtight homes with central air handlers



Integrated HRV: Builder Benefits

An integrated system using existing HVAC ductwork...

- Requires the least amount of additional ductwork to be installed
- Saves cost
- Reaches all the rooms you want supplied with fresh air
- Actually brings the V back into an HVAC total system

Integrated HRV: Selling to Homeowners

Sales Talk

- Differentiation! Link higher indoor air quality to a tangible product
- Exhaust is taken directly from the rooms where moisture and other pollutants are generated. This isn't just a design requirement, it's a benefit.
- Distributed fresh air throughout the house, not simply in one zone
- An energy-efficient home should have an energy-efficient fresh air solution
- Healthier and happier homeowners

For more great ways to talk about your new ventilation system with homeowners and real estate professionals, check out: <https://basc.pnnl.gov/sales-tool>

Integrated HRV: (Perfect) Definition

- A heat recovery ventilation system that makes use of an existing whole-house air handler for distribution of fresh supply air (typically through your furnace or heat pump).
- Must pull air directly from bathrooms and high moisture areas
- Takes advantage of both independent and central H/AC controls

HE or High Efficiency HRV models are defined as:

- SRE 80% or higher
- Efficacy 1.25 CFM/watt (.8 watts/cfm)

Integrated HRV: Ideal Features

Ideal features of a properly installed integrated HRV

- Distributed ventilation
- Pulls EXHAUST air from bathrooms and other areas of high moisture or pollutants
- Comfortable air temperatures
- Filtered air
- Energy efficient
- Straightforward installation
- The homeowner keeps it on!

Integrated HRV: Rules for Success

The golden rules (in a perfect world)

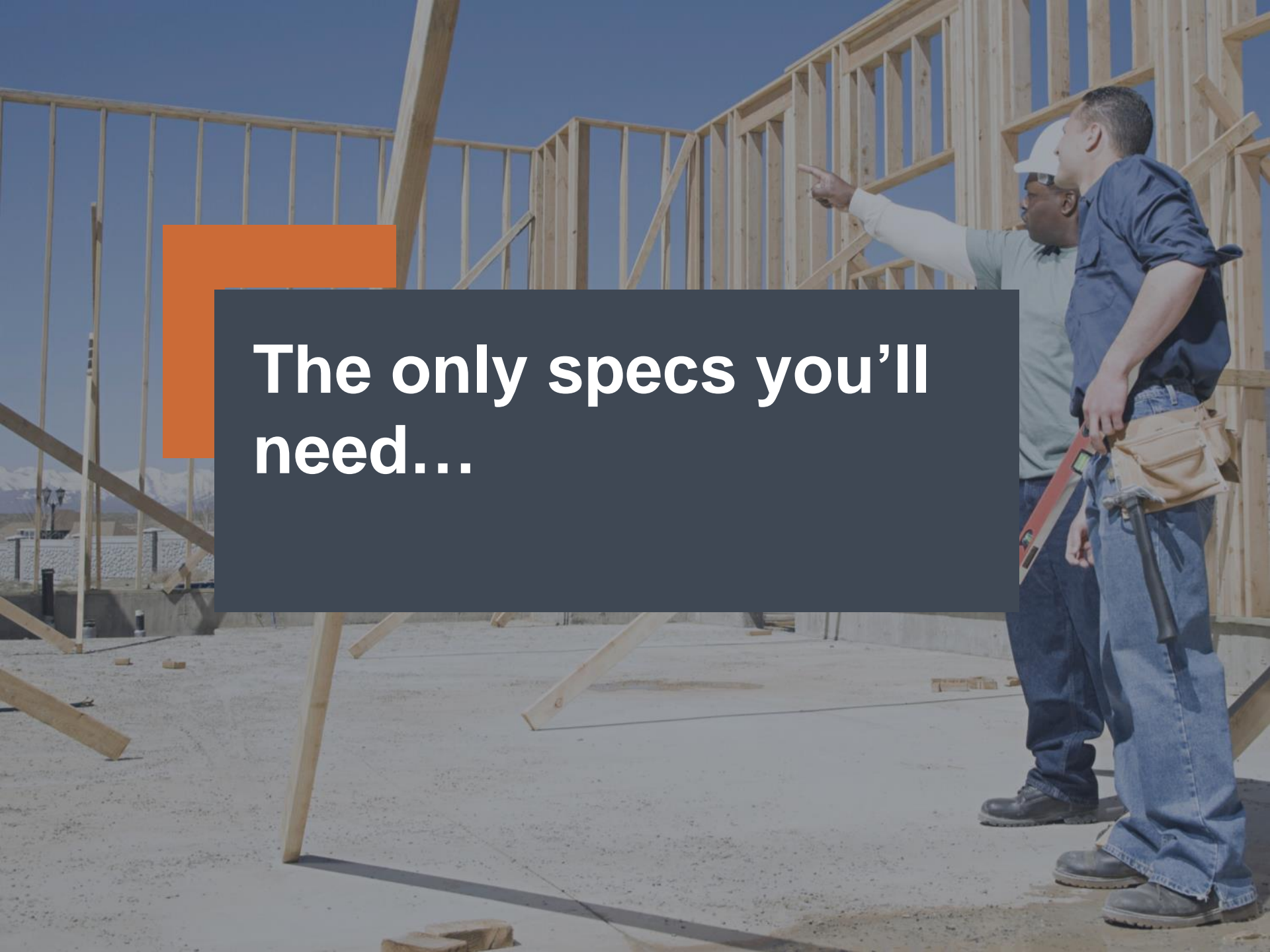
1. Integrated fresh air into the supply
 - No tying into returns
2. Uses injection design
 - Use turns, not Ts
3. Energy Efficient
 - HRV has SRE 80% or higher
 - Fan that moves at least 1.25 CFM/watt (.8 watt/CFM)
 - Central air handler can operate very efficiently at low fan speed (16 pin ECM)
4. Pull exhaust air from bathrooms

Practice



Can you explain the value of adding an integrated HRV to a building? Prove it!

1. Turn to the person to your right.
2. Explain the value proposition of adding an integrated HRV compared to typical exhaust-only or spot ventilation found in bathrooms and kitchens.
3. Optional: Share a convincing value proposition you heard today

A photograph of two construction workers on a building site. The worker on the left is wearing a white hard hat, a light green long-sleeved shirt, and dark pants, pointing towards the wooden frame of a building. The worker on the right is wearing a blue short-sleeved shirt, blue jeans, and a tan tool belt, holding a red level. The background shows the wooden skeleton of a building under construction against a clear blue sky. An orange square is positioned to the left of the text box.

**The only specs you'll
need...**

Learning Objectives



After this training, you will be able to...

1. Explain the value of adding an Integrated HRV to a building
2. Identify the rationale behind the integrated injection HRV efficiency spec
3. **Find resources to support the installation of integrated HRVs**

HRV Specification

1. Air Handler and HRV must use one of these control modes:
 - **Mode A** - HRV runs continuously and system cycles AH with a smart controller (or AH runs continuously as well)
 - **Mode B** - Use an HRV with built in dampers that close when not supplying air; no restrictions on AH use
 - **Mode C** - Interlock the HRV controls to the AH fan so that the AH cannot run without the HRV
2. HRV exhaust pulls from places where contaminants are common
3. Injection port design
4. Ventilation system sized to meet program requirements at the middle of the flow range
5. SRE >80% and high fan efficacy (1.25 cfm/watt)
 - Numbers at lowest tested net supply airflow

HRV Specification

HVI Products Listing

Energy Ratings

| Full Report More ▾ | | 3 Energy data points | | | | | |
|----------------------|-------------|----------------------|----|---------------------|-------------------|------------------------|------------------------------|
| | ▲ Temp Mode | °C | °F | ▾ Net Airflow (L/s) | Net Airflow (cfm) | Power Consumed (Watts) | Sensible Recovery Efficiency |
| | HEATING | 0 | 32 | 31 | 65 | 34 | 86 |
| | HEATING | 0 | 32 | 41 | 87 | 44 | 86 |
| | HEATING | 0 | 32 | 51 | 108 | 60 | 86 |

Operating Mode A

Intermittent/continuous central H/AC fan operation with continuous HRV

- Ventilation cycles (not heating and cooling cycles) set to run close to minimum fan speed, is <40 watts (16 pin designed ECM air handler meets this)

Why?

- Meets distribution requirement by minimizing fan energy use/noise
- Mitigates delivery air temperatures during off duty run cycles

Operating Mode B

Intermittent central H/AC fan operation with intermittent HRV

- Ventilation cycles (not heating and cooling cycles) set to run close to minimum fan speed, is <40 watts (16 pin designed ECM air handler meets this)
- Either HRV comes with built in backflow dampers, or additional dampers are installed to prevent backflow from when AH is on and when HRV is off.

Why?

- Saves energy when compared to continuous
- Meets distribution goal while minimizing fan energy use and noise
- Prevents the reverse flow through the supply half of the HRV when AH is on and HRV is off

Operating Mode C

Interlock the HRV controls to the AH fan, so that the AH cannot run without the HRV

- Controls must be set properly to operate both systems such that HRV runs when calls for heating and cooling, as well as calls for AH to run during partial load days when system calls for ventilation.

Why?

- Prevents energy costs for unnecessary run times
- Maximizes distribution with every call for ventilation, while ensuring that all heating and cooling runs integrate ventilation.

Calculators Are Available

Math is hard!

But it doesn't have to be!



RED Calc Free Tools

- Getting Started
- Tool Descriptions
- Preferences
- Ventilation
 - ASHRAE 62.2-2016**
 - ASHRAE 62.2-2013
 - ASHRAE 62.2-2010
 - ASHRAE 62.2 CA
 - Electrical Usage
 - Depressurization
 - Pitot Tube Airflow
 - Box Airflow
- Moisture
 - Moisture Metrics
 - Wood Moisture
- Air Leakage
 - Air Leakage Metrics
 - ZPD
 - Design Infiltration
 - Advanced Infiltration
- Insulation
 - Dense Pack
 - Loose Fill
 - Heat Transfer
 - Infrared R-Value
 - Parallel Path R-Value
- Domestic Hot Water
 - Systems Comparison
 - Average Daily Usage
 - First Hour Rating
 - Instantaneous Sizing
 - Volume per Use
 - Water Flow Rate
- Weather Data
 - Weather Station Data

YouTube Twitter g+

Join RED Newsletter

• Click the label of any input or result for Pop-Up Help •

RED ASHRAE 62.2-2010 Ventilation [Reset] [Print] [i]

New or existing construction [Existing ▾]
Use infiltration credit [Yes ▾]

Closest weather station [- Select a Country - ▾]
Weather factor [1/hr] =

Floor area [ft² ▾] []
Number of occupants [▾]
Building height [ft ▾] []
Measured leakage @ 50Pa [CFM ▾] []

Use Advanced Blower Door Inputs

Use Local Ventilation Alternative Compliance

Whole-Bldg Ventilation Results

N-factor₂₀₁₀ =
Natural airflow [CFM ▾] =
Total required ventilation rate [CFM ▾] =
Infiltration credit [CFM ▾] =
Required mechanical ventilation rate [CFM ▾] =

Whole-Bldg Ventilation Run-Time Tool

Fan capacity [CFM ▾] []
Fan run-time per hour [min ▾] =

Version 2016-07-06 01:30 © 2016 Residential Energy Dynamics, LLC

HRV Specification Requirement 2

HRV exhaust pulls from places where contaminants are common (not connected to central return duct)

Why?

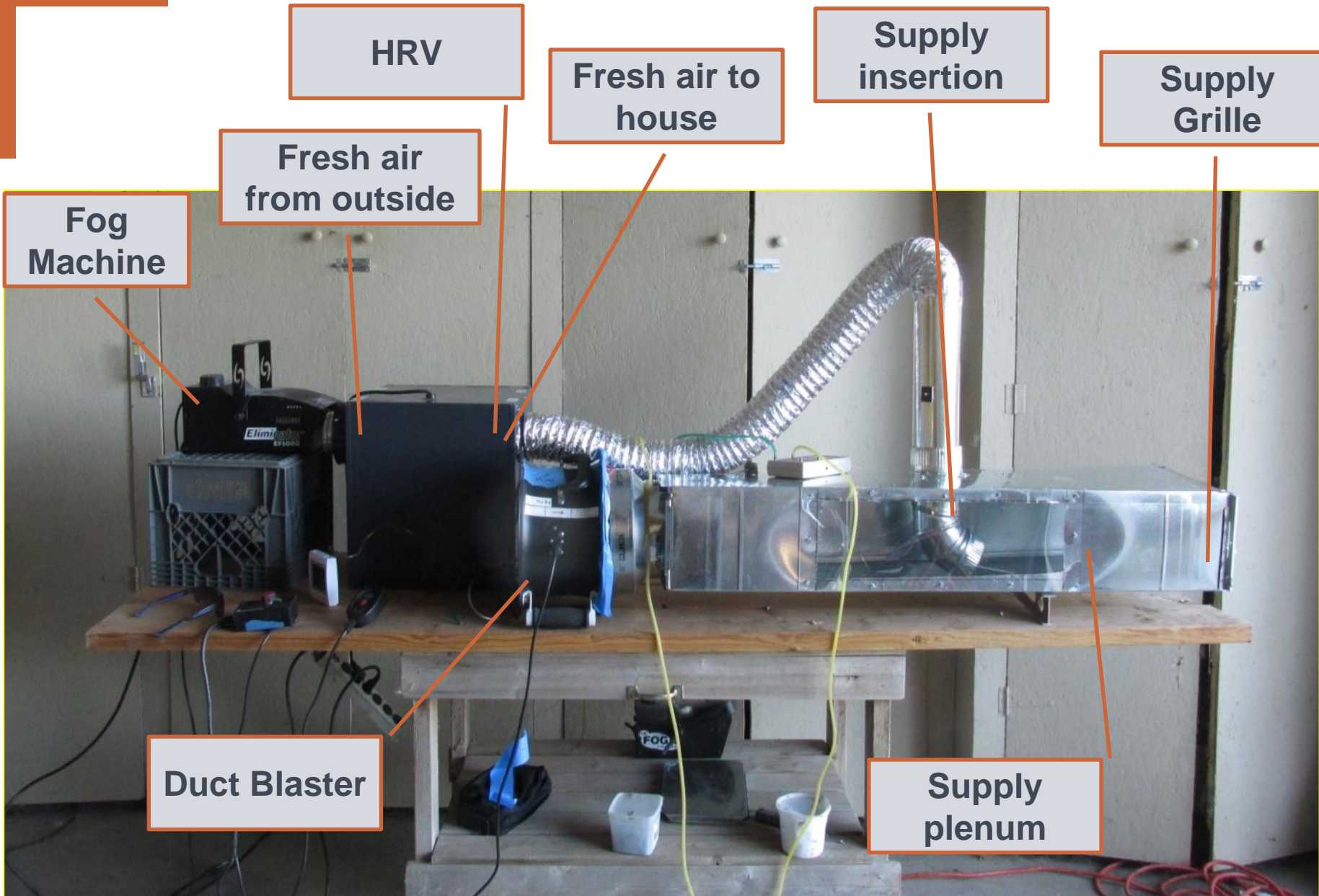
- Prevents pressures of the central fan duct system from overpowering HRV exhaust during on duty cycles (Return suckage sucks!)
- Heat recovery opportunities from bathroom
- Offsets HRV costs by eliminating laundry or ½ bath fans
- Opportunities to pull air from high contaminant locations (for example all bathrooms)

HRV Specification Requirement 3

Injection Port Design: HRV supply into supply central duct system

Why?

- Ensures fresh air into all rooms of the house
- Reduces pressure blocks in the supply ducts (which may lead to imbalanced HRV supply vs return flows)
- No need to build a separate supply system



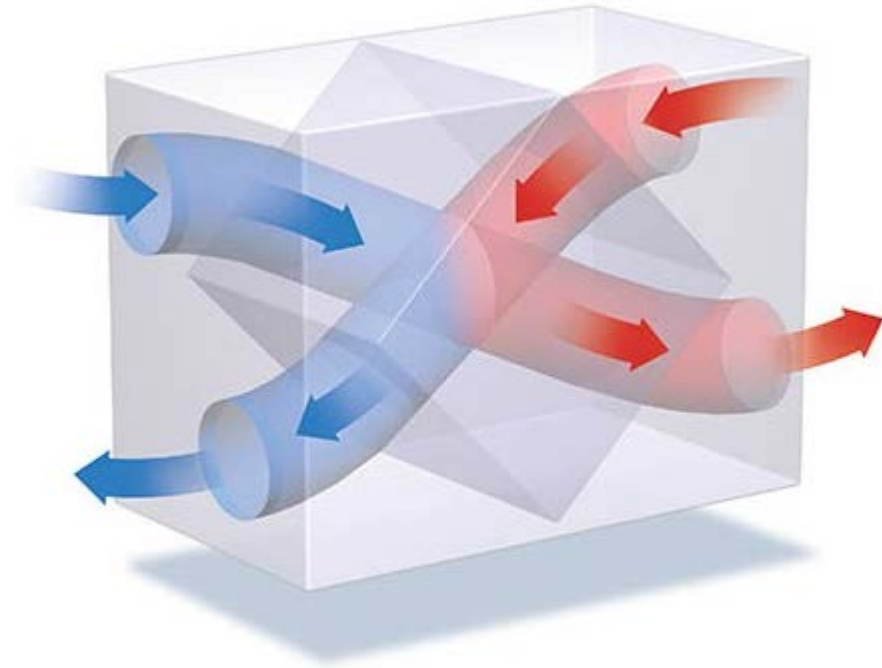
The Fog Machine Test



Pushing Air Into the Return Side is BAD

Return side can result in...

- Very large imbalances
- Over ventilation
- Outside air sucked into the HRV at higher rates than designed



HRV Specification Requirement 4

System sized to meet program standards at the middle of the HRV flow range

- ASHRAE 62.2 most often meets this

Why?

- It meets code
- Program standards are designed to meet the minimum requirements to deliver fresh air into living spaces
- Programs and certain standards are regularly being updated to reward smart design
- Prevents wasting money on an additional ducting and labor

HRV Specification Requirement 5

SRE >80%, Efficacy >1.25cfm/watt

Why?

- A high SRE ensures efficiency and energy transfer in HRV
- A high ASE—a result of high SRE—ensures effectiveness and temperature transfer in HRV
 - This ensures delivered air temperature meets occupant comfort standards during off duty cycles (it pre-conditions the air avoiding cold air onto occupants)
- High efficacy ensures low fan energy required to operate HRV

Sometimes though, we don't have the room, choice, or ability to inject into the supply...

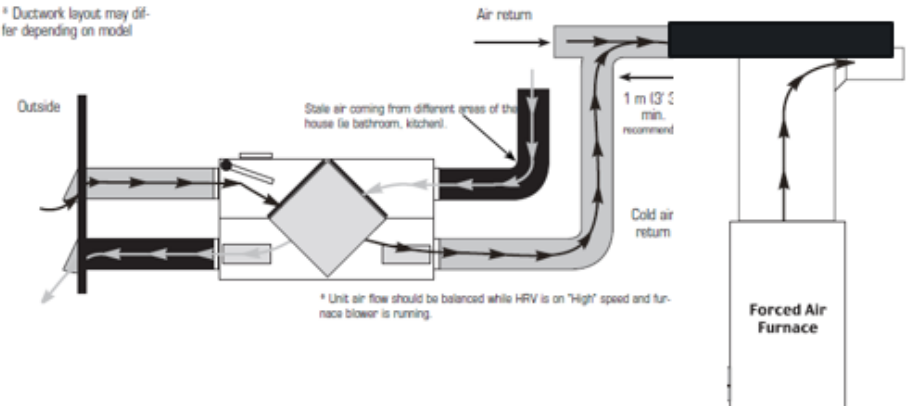
Consider these practices

- Don't install filter grills
- Constant air regulators can be your friend
- Oversize the return duct

Stale air from house; fresh air to return

HRV/Furnace ducting for Partially Dedicated System

* Ductwork layout may differ depending on model



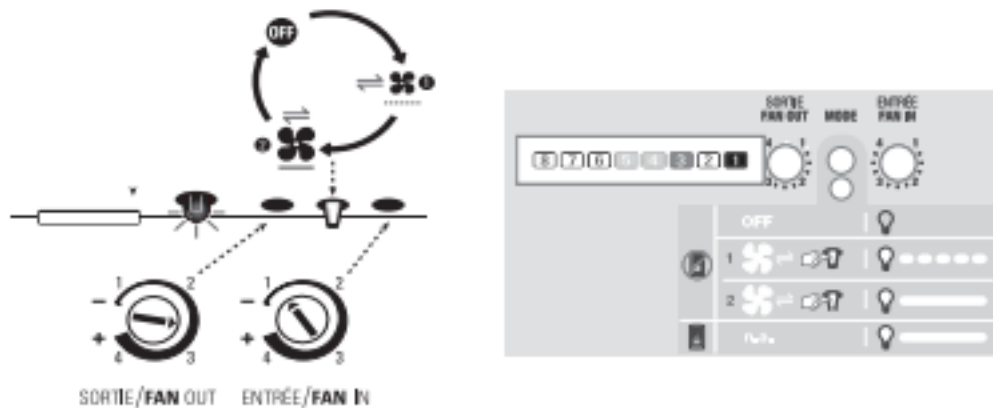
Aldes E80 HRG



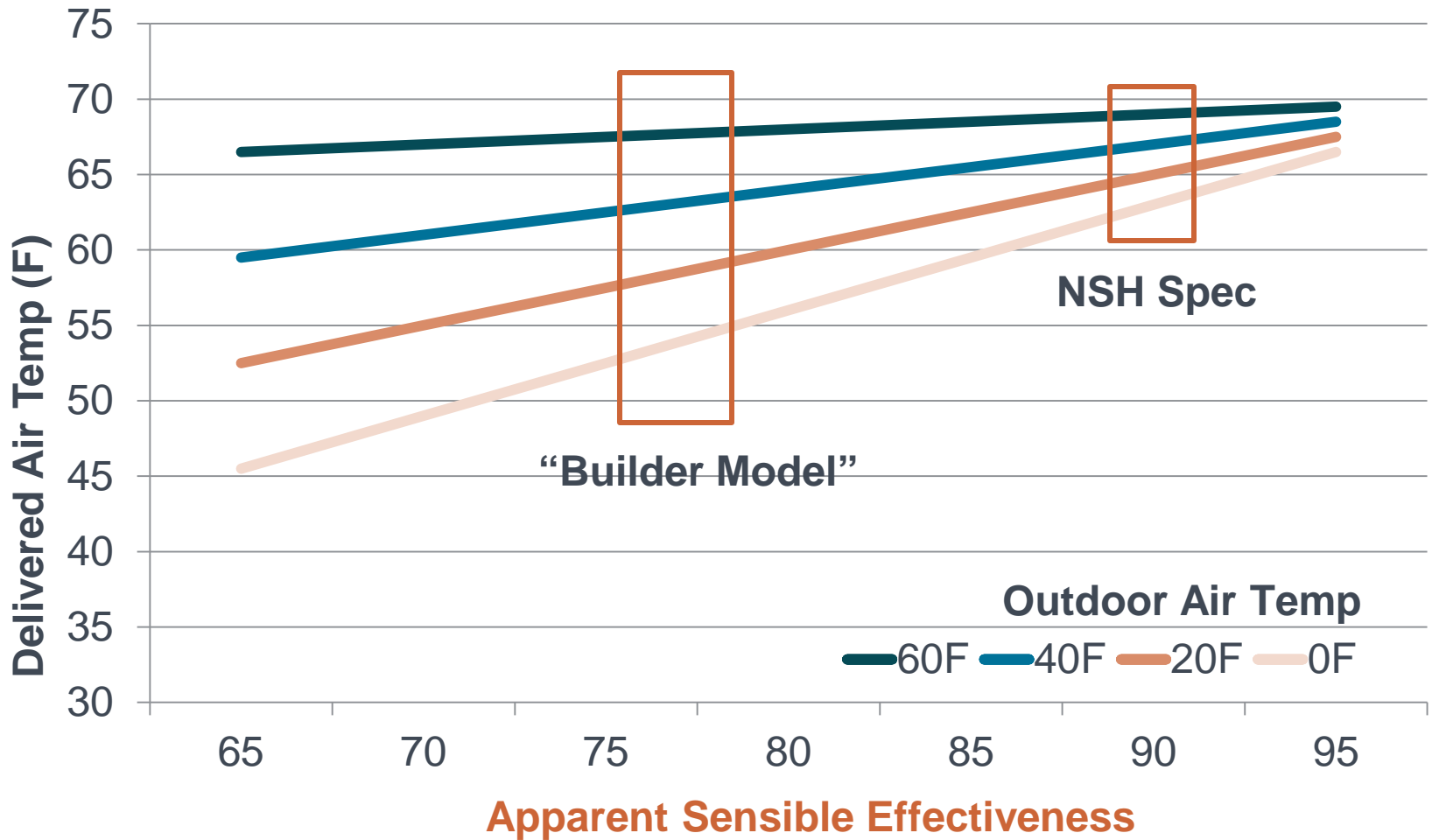
Adjust the fan not the pressure

POTENTIOMETER style interface

For this series, the speed of the blower is adjusted with two potentiometers; one for the SUPPLY (FAN IN) and one for the EXHAUST (FAN OUT) (see figure below). The installation must balance air flow brought in from the outside and the exhaust air flow so that the difference between the two is less than 10% of the maximum air flow. This air balance is especially important in homes using a combustion device or in those located in areas where the ground emits radon.



ASE: Why It Matters



Statement of Work

What to document

- Airflow of both streams
- Opening and closing of dampers
- Amp draw of air handler fan on low speed
- Room by room airflows
- Condensate pipe routing

Who needs to know

- Rater/auditor
- Builder/contractor
- Perhaps code official

Resources

- Manufacturer's website
- [HVI Product Directory](#)
- [ENERGY STAR](#)
- [HRV System Best Practices Poster](#)
- [Building Science Corporation](#)
- [Building Science Translator](#)
- [Building America Solution Center](#)
- [Canadian Guide to HRVs](#)

HRV SYSTEM BEST PRACTICES FOR THE NORTHWEST

Achieving reliable ventilation effectiveness in relatively tight homes requires a balanced system. Heat recovery ventilators, HRVs, are the optimal house ventilation system for the Northwest. Energy recovery ventilators, ERVs, are better suited for humid climates and do not perform well in our dry as summer conditions. Due to complexity and added operational costs, we do not share successful integrated ERV/ERV+ systems. Read below for tips and recommendations to make the most of your HRV installation—unless properly designed, installed and operated, an HRV may not save more energy than an exhaust fan.

1 Planning

2 Installation

3 Testing & Commissioning

4 Delivery of Temperature Versus Outdoor Temperature and AHRV

1 Planning

2 Installation

3 Testing & Commissioning

4 Delivery of Temperature Versus Outdoor Temperature and AHRV

5 References

6 Glossary

7 Appendix

8 Acknowledgments

9 About the Authors

10 Contact Information

11 Disclaimer

12 NorthWest Energy Star

Practice



**SRE has to be >80% efficacy equal of >1.25 cfm/watt.
Why is this important?**

- a) Avoids possibility of blowing cold air on occupants
- b) Ensures the heat energy recovered outweighs cost of operation
- c) All of the above

Practice



Why does the spec call for injection and not simply “T’ing” the fresh air supply from the HRV to the supply plenum?

- a) Back drafting of HRV is much less likely
- b) Without the inserted elbow, the air doesn’t know which direction move
- c) An inserted elbow has a lower equivalent length than a simple T
- d) All of the above

Practice



Resources are available to support the installation of integrated HRVs. Where should you begin?

- a) Use available tools and web resources!
- b) Call the manufacturer or fancy expert
- c) Work with a knowledgeable Rater and/or HVAC designer
- d) All of the above

Overview

- Choose to install an integrated HRV
- Use available resources
- Get assistance with:
 - Selecting the right HRV system
 - Injection into the HVAC system
 - Selecting the right air handler
 - Placement of HRV
- Sell fresh, clean air

Goal Setting

List one thing you can do within the next week to explore an HRV installation

- By next week we will...



THANK YOU

Bruce Manclark

Director of Special Projects, Consultant
Residential New Construction Programs

<https://www.linkedin.com/in/brucemanclark>

Dan Wildenhaus

Sr. Building Science Specialist
Residential New Construction Programs

<https://www.linkedin.com/in/danwildenhaus>