State of MN
Energy Code Ventilation Review
for
2017
Energy Design Conference

By

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Dakota Supply Group

- In accordance with the Department of Labor and Industry's statute 326.0981, Subd. 11,

  "This educational offering is recognized by the Minnesota Department of Labor and Industry as satisfying **1.5 hours** of credit toward **Building Officials and Residential Contractors code/energy** continuing education requirements."

  For additional continuing education approvals, please see your credit tracking card.

Overview

- Learn about MN Energy Code as it applies to Balanced Ventilation
- Ventilation system sizing
- Gain an understanding on the pros and cons of different duct designs
- Find out what the difference between HRV/ERV is
- A brief discussion on winter time humidity control
- Selection and operation of ventilation controls
- Why verification of operation (balancing airflows) is an important detail
- Some ideas on maintenance

OUTLINE

- ENERGY CODES
- SIZING AND DUCT DESIGN
- HRV AND ERV
- WINTER TIME ON HUMIDITY
- CONTROLS
- BALANCING
- MAINTENANCE

Methods of Ventilation

- Continuous: Sometimes referred to as general, central, or whole-house ventilation. Should be quiet ,low volume, and continuous ventilation
- Intermittent: Sometimes referred to as spot, local, or source point ventilation. Commonly used in bathroom, kitchen, laundry, hobby, and home office. Should remove excessive moisture and pollutants quickly

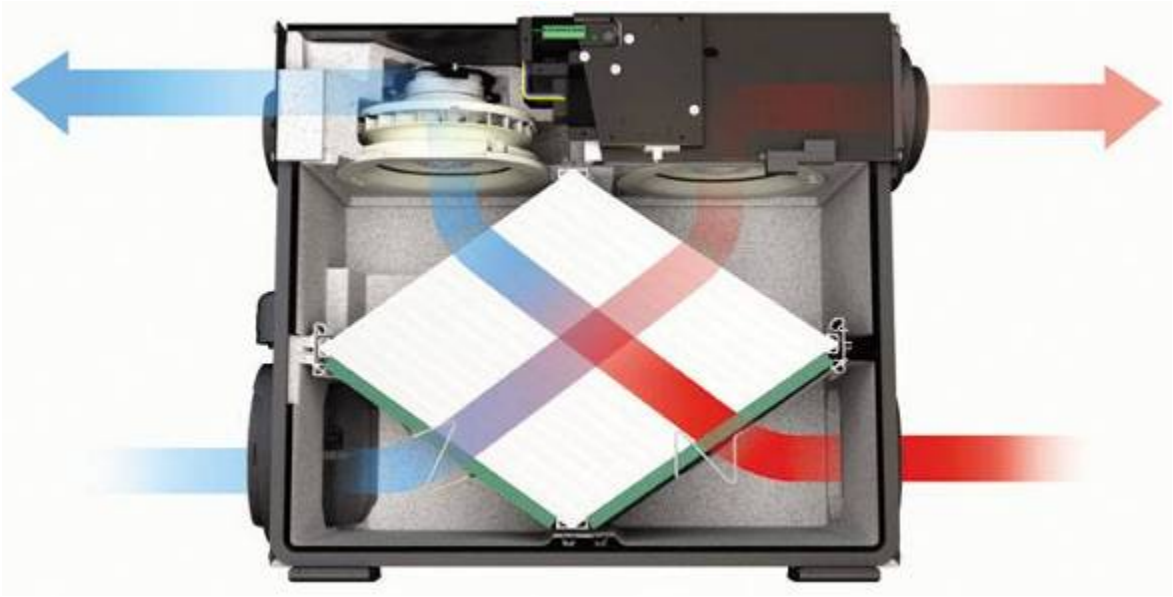
Ideally, an airtight home designed with both continuous and Intermittent ventilation will contribute to a healthy and comfortable living environment for the entire family

Ventilation Terminology

- CFM… Cubic feet per minute
- Sone… An internationally recognized measurement of sound output
- HRV… Heat recovery ventilator
- ERV… Energy recovery ventilator
- ACH… Air changes an hour
- P.A. … Pascal, a measurement in pressure
- HVI… Home Ventilation Institute

BALANCED VENTILATION- HOW DOES IT WORK

Stale air to outside



Fresh air to the home

Fresh air from outside

Stale air from the home

BALANCED VENTILATION SYSTEM CHECK LIST

- ✓ Size air flow properly
- ✓ Size and seal duct work
- ✓ Choose rated / labeled product
- ✓ Use good controls
- ✓ Integrate with other systems
- ✓ Test, measure, balance
- ✓ Put the V back in HVAC

Home Ventilating Institute

1. Tests and labels product
2. Verifies performance
   (air flow and sound / sone)
3. Provides listing of products
   online www.hvi.org

ES = Energy Star

If the unit is an ENERGY STAR RATED unit

- These units have better insulation, higher heat/energy recover
- Better core design
- 1.2 CFM per watts of electrical energy
- Better performance at 32 and -13 degrees

2015 MN Residential Energy Code
R403.5 Mechanical Ventilation

Mechanical ventilation

- Shall be provide with balanced ventilation that is +/- 10 percent f design capacity
- All conditioned areas… no change from previous code
- Outdoor air intakes and exhaust shall have automatic or gravity dampers that close when the ventilation system is not operating
- Kit and bath fans exempt
- 1 hour period

R403.5.5 Balanced and HRV/ERV systems

- Balanced with in 10% air flow
- HVI tested to – 13 Fahrenheit or certified by engineer
- Total and continuous shall be balanced or exception
- Continuous can be balanced and low sone fan to meet intermittent

R403.5.10 DAMPERS

- Ventilation system supply and exhaust shall have accessible backflow dampers to minimize flow to the outside when system is off

DAMPERS ARE CITED THREE TIMES IN THIS SECTION OF THE CODE

- R403.5
- R403.5.10
- R403.5.14

AT THIS TIME EQUIPMENT AND SYSTEM THAT ARE BEING INSTALLED THAT DOES NOT MEET THESE REQUIREMENTS

MN ENERGY CODE SECTION R 403, CODE VIOLATION ISSUES

Why dampering to the outside is important

IF DAMPERS ARE NOT INTERGRATED INTO THE HRV/ERV UNIT OR INSTALLED INTO THE SYSTEM AT TIME OF INSTALLATIC

This guide makes reference to dampering to the outside.

The following points are the technical reasons why it is in the code three times
At this time 11-2016 there is equipment and installation that are being installed that do not meet these requirments in metro and outstate MN
This information is a culmination of 30 years of experience as a installing ventilation contractor, inspecting and servicing several different brands HRV/ERV, consulting on field reserch projects and working with th

The following information have been field verified by myself and other dianostic professoinal that have national testing credentials .

Equipment operation — Furnace fan on and HRV/ERV off

potential 50% run time percentige run timer

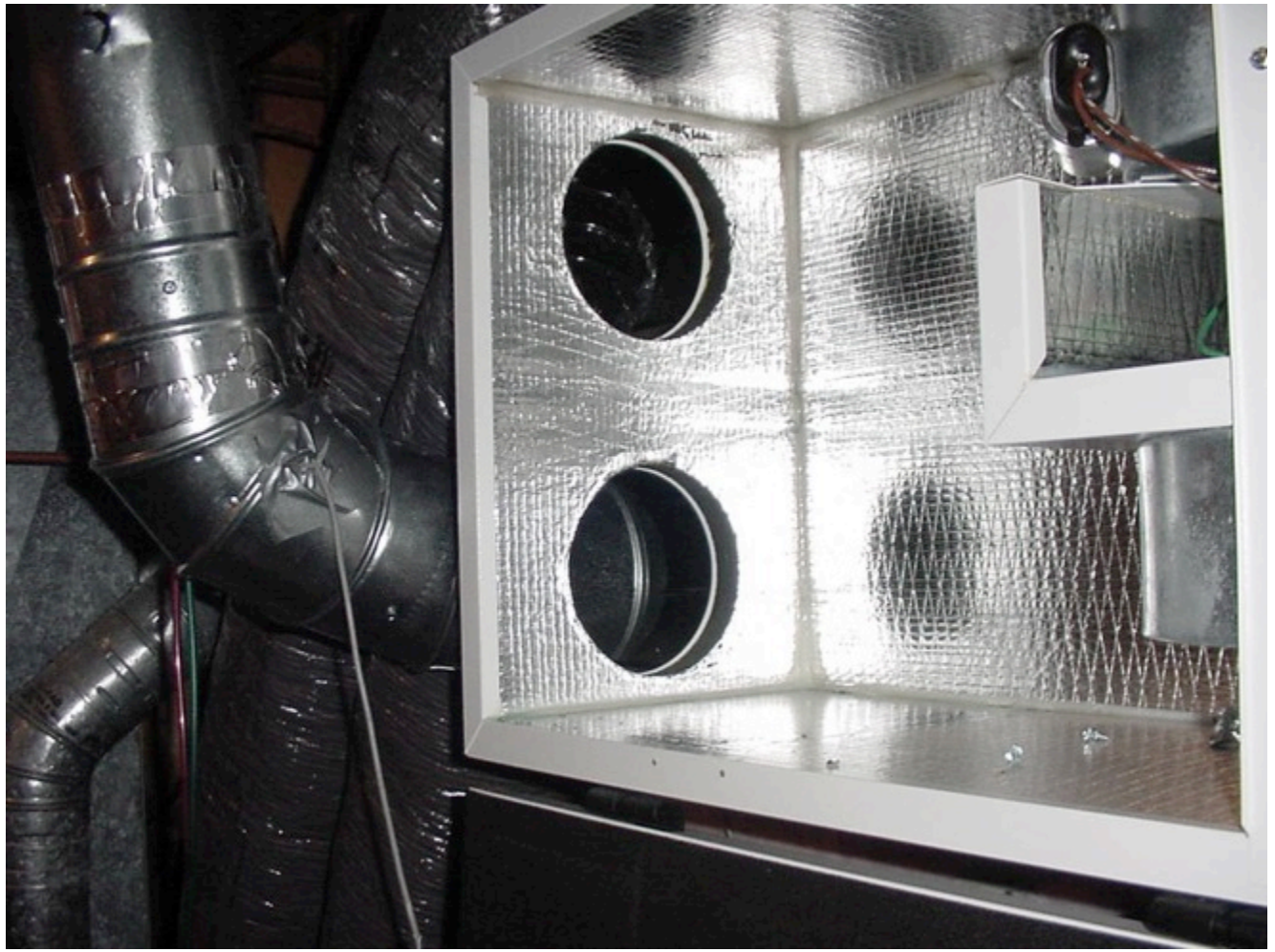
call backs issues for homeowner, builder, hvac

	comfort	Higher cooling and heating costs	building durablity moisture	problems	equipment durablity warranty	thermal shock	code violation	wood work separation flooring movement	natural draft equipment backdrafting	(CO, smoke issues)
Over drying in winter, low RH% (Need to add Humidifier)	O	O						O		
Air Conditioning works longer to cool and dehumidify	O	O								
Furnace takes longer to heat house	O	O								
Building shell pressuration (positive pressure)			O							
Building shell depressuration (negative pressure)	O	?							O	
Uncontrolled ventilation	O	O			O					
Exhaust port becomes a intake *	O	O	O		O			O		
May effect core performance core freeze/upblockage					O					

* code violation , a exhaust port that acts like a intake could potentially bring combustion products into the home

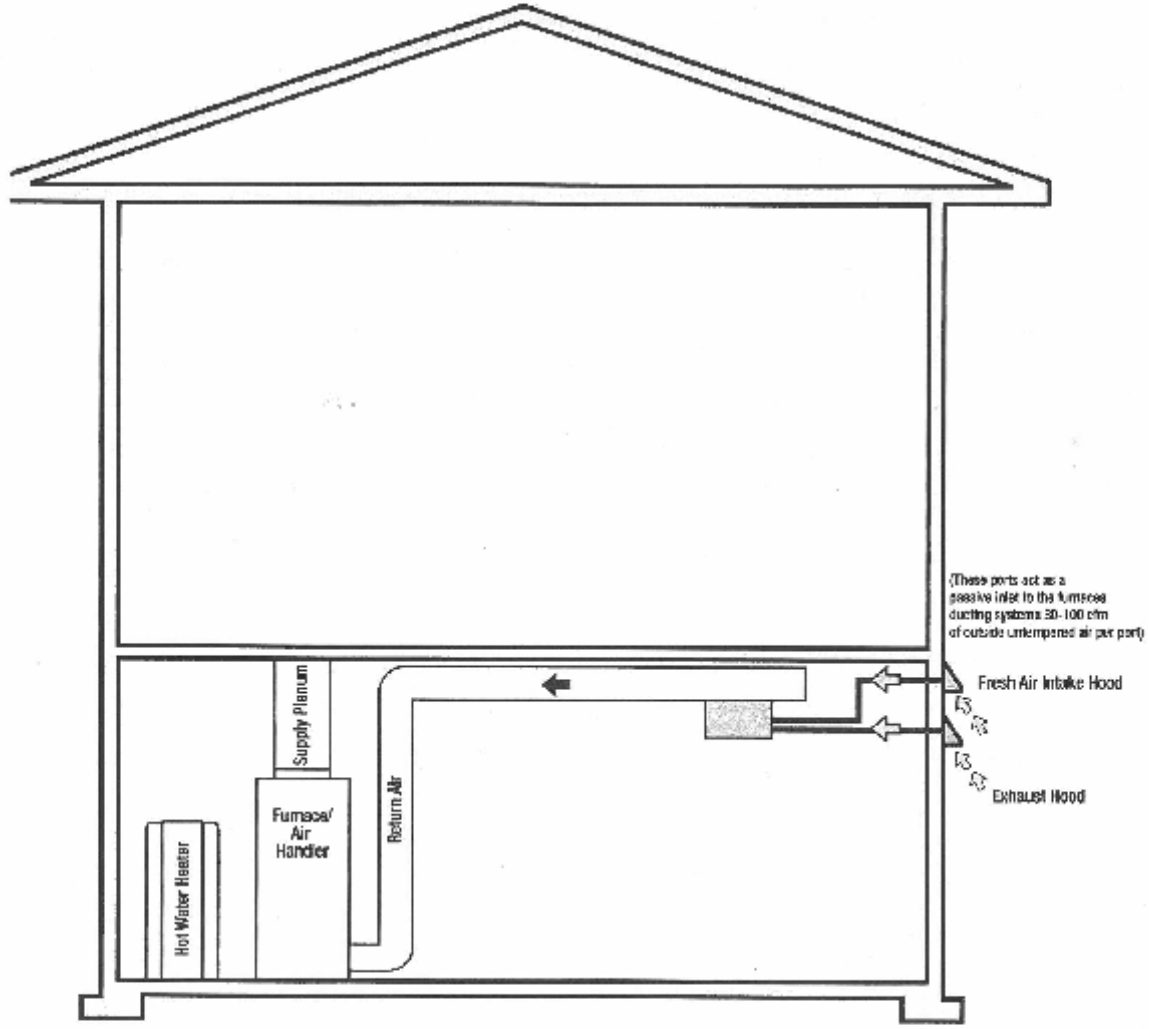
depending on operation of equipment, duct design of ventilation system and weather condition can vary the level of problem that may occur

HRV/ERV SYSTEM WITH NO DAMPERS

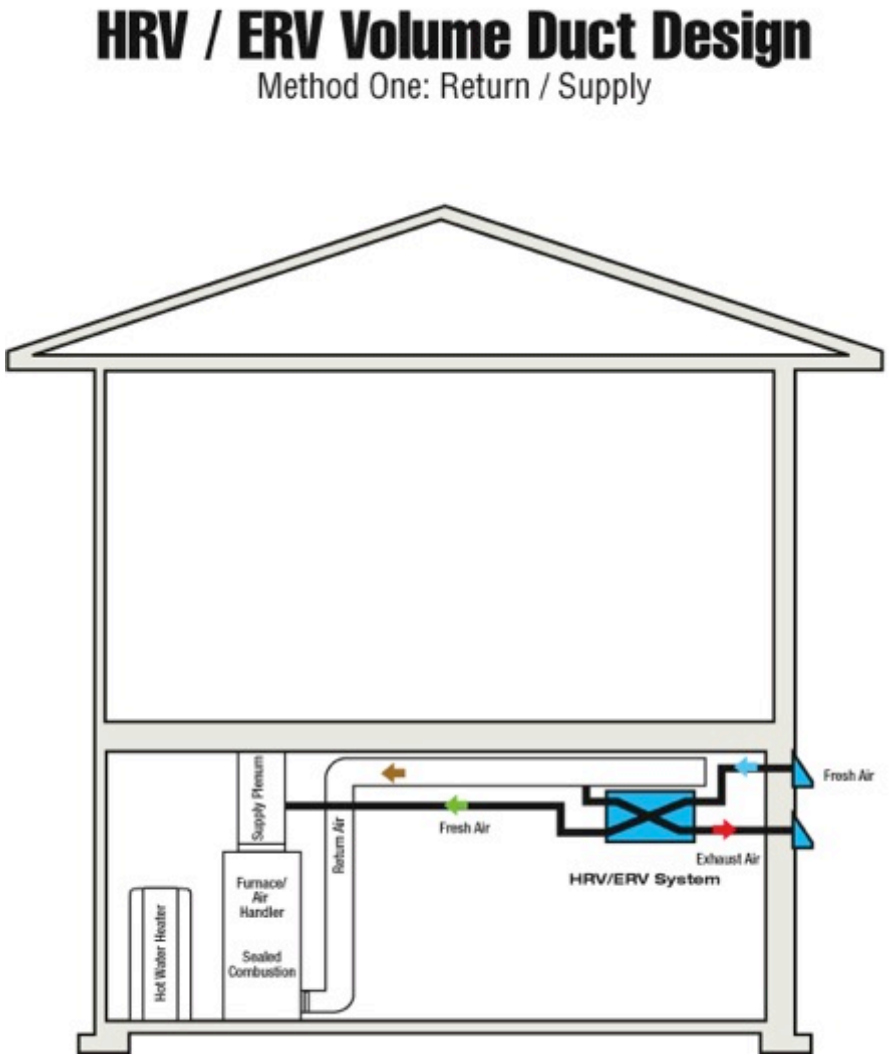


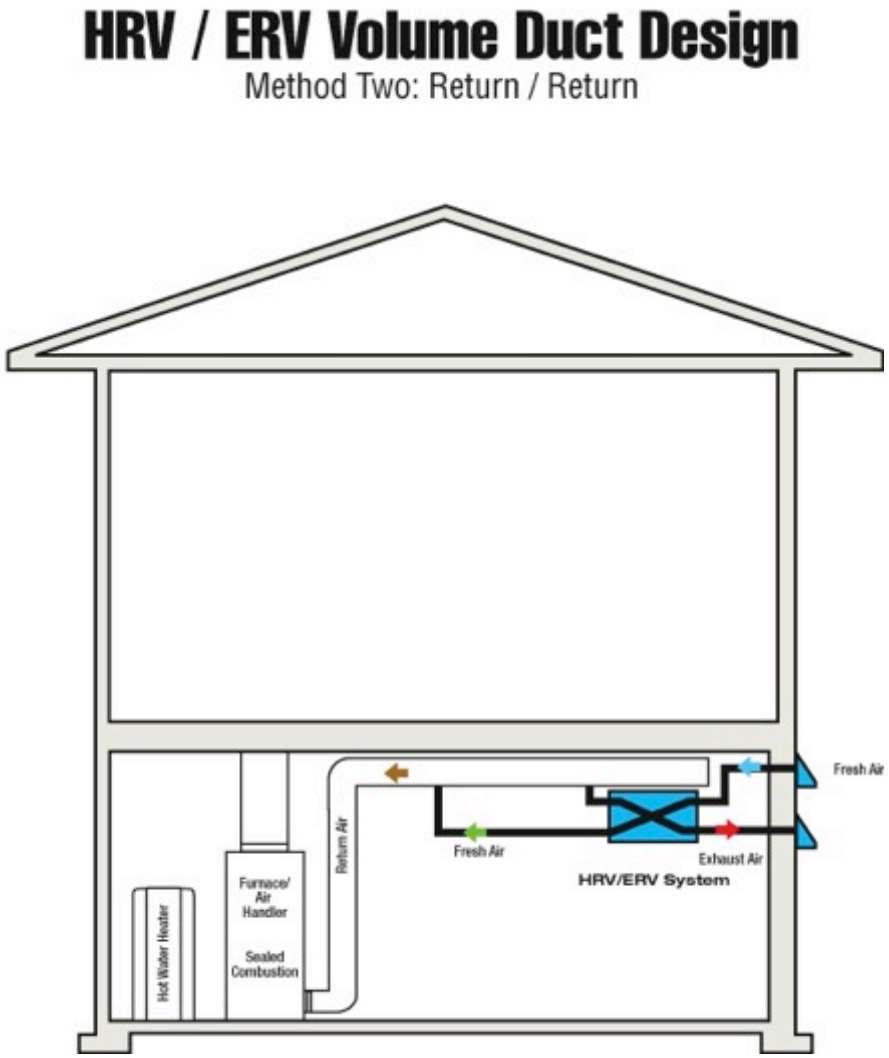
Return-Return Duct System

No Dampers



DAMPERING DESIGN GRAPHIC





R 403.5.13 Noise and vibration

- Isolation duct connection shall be used to mitigate noise transmission

VIBRATION FLEX- DUCT DETAIL

R403.5.6.1 Air distribution/circulation

- 0.075 cfm per conditioned floor area
- No less then 40 degrees at grill

R403.5.12 Filtration
R403.5.15 Labeling
R403.5.16 Documentation

- Outdoor air needs to have MERV 4 filter
- Hoods need to be marked
- Operation and maintenance instruction

VENTILATION SIZING

- Calculation example
- Table R403.5.2
- Sizing for Total TVR
- Sizing for Continuous CRV

Mechanical Ventilation Design

- Size you HRV/ERV or Balanced to meet TVR
- Size you HRV/ERV or Balanced to meet just CVR

- Exception under R403.5.5 Balanced and HRV/ERV systems

“ The balanced system and HRV/ERV system may include exhaust fans to meet the intermittent ventilation rate. Surface mounted fans shall have a maximum 1.0 sone per HVI Standard 915”

Mechanical Ventilation

- Total Ventilation Rate (cfm) = (0.02 x sq. ft. of condition space) + (15 x (number of bedrooms + 1))
- Continuous Ventilation Rate (cfm) = is a minimum of 50% of the TVR
- TVR = Total Ventilation Rate
- CVR = Continuous Ventilation Rate

OR YOU CAN USE THE FOLLOWING TABLE

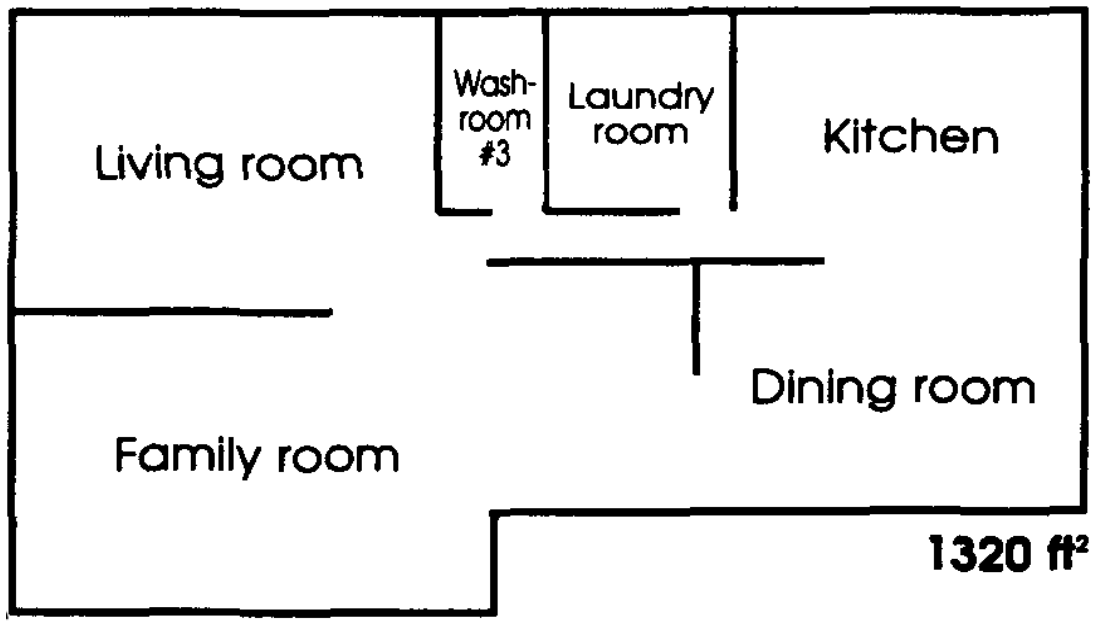
TABLE R403.5.2
TOTAL & CONTINOUS RATES (IN CFM)

Conditioned space[1] (sq. ft.)	NUMBER OF BEDROOMS					
	1	2	3	4	5	6
	Total/ Continuous	Total/ Continuous	Total/ Continuous	Total/ Continuous	Total/ Continuous	Total/ Continuous
1000-1500	60/40	75/40	90/45	105/53	120/60	135/68
1501-2000	70/40	85/43	100/50	115/58	130/65	145/73
2001-2500	80/40	95/48	110/55	125/63	140/70	155/78
2501-3000	90/45	105/53	120/60	135/68	150/75	165/83
3001-3500	100/50	115/58	130/65	145/73	160/80	175/88
3501-4000	110/55	125/63	140/70	155/78	170/85	185/93
4001-4500	120/60	135/68	150/75	165/83	180/90	195/98
4501-5000	130/65	145/73	160/80	175/88	190/95	205/103
5001-5500	140/70	155/78	170/85	185/93	200/100	215/108
5501-6000[2]	150/75	165/83	180/90	195/98	210/105	225/113

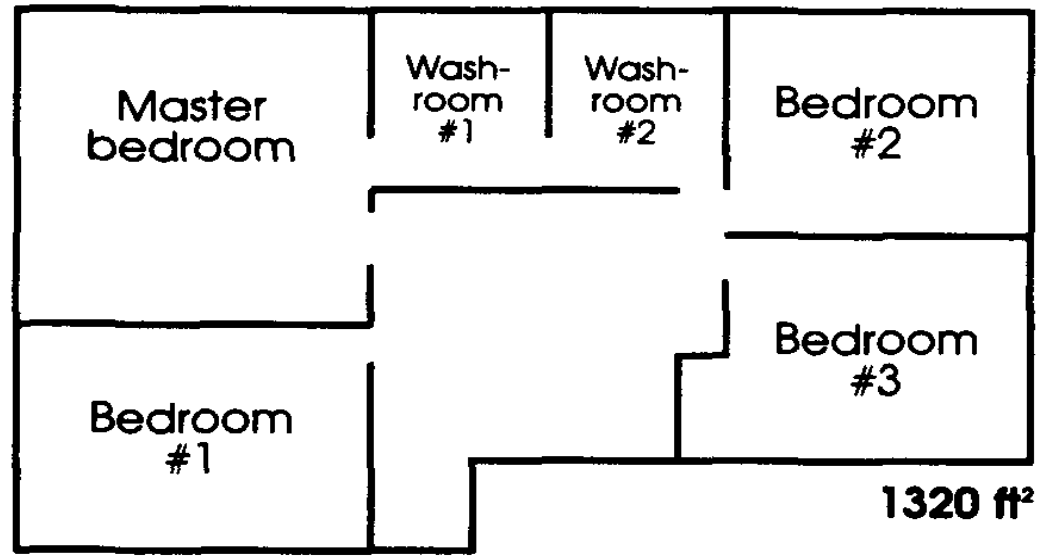
VENTILATION SIZING CALCULATION EXAMPLE

- CALCULATION
- USING THE TABLE
- SIZE OF THE HOUSE , TOTAL SQUARE FOOTAGE, BEDROOMS
  - 2640 SQ. FEET
  - 3 BEDROOMS

Main floor



Second floor



VENTILATION CALCULATION EXAMPLE

- Total Ventilation Rate (cfm) = (0.02 x sq. ft. of condition space) +

(15 x (number of bedrooms + 1))

  - TVR= (.O2 X 2640 SQ FT) + (15 X (3 + 1))
  - TVR= 58.2 + 60 = 112.8 CFM

- Continuous Ventilation Rate (cfm) = Total ventilation rate (50 %)
  - CVR= 112.8 X .5 = 56.4 CFM

FROM TABLE R403.5.2

TVR= 120

CVR=60

TABLE R403.5.2
TOTAL & CONTINOUS RATES (IN CFM)

Conditioned space[1] (sq. ft.)	NUMBER OF BEDROOMS					
	1	2	3	4	5	6
	Total/ Continuous	Total/ Continuous	Total/ Continuous	Total/ Continuous	Total/ Continuous	Total/ Continuous
1000-1500	60/40	75/40	90/45	105/53	120/60	135/68
1501-2000	70/40	85/43	100/50	115/58	130/65	145/73
2001-2500	80/40	95/48	110/55	125/63	140/70	155/78
2501-3000	90/45	105/53	120/60	135/68	150/75	165/83
3001-3500	100/50	115/58	130/65	145/73	160/80	175/88
3501-4000	110/55	125/63	140/70	155/78	170/85	185/93
4001-4500	120/60	135/68	150/75	165/83	180/90	195/98
4501-5000	130/65	145/73	160/80	175/88	190/95	205/103
5001-5500	140/70	155/78	170/85	185/93	200/100	215/108
5501-6000[2]	150/75	165/83	180/90	195/98	210/105	225/113

SIZING OPTION 0NE

- Size your HRV/ERV or Balanced to meet TVR
- Both Continuous and Intermittent must be balanced

SIZING OPTION TWO

- Size you HRV/ERV or Balanced to meet just CVR
- Install a surface mounted fan that is rated at 1.0 sone or less , this is your intermittent ventilation
- If this method is used, air flow needs to be verified on HRV/ERV and exhaust fan that is designed for the intermittent ventilation

EQUIPMENT SELECTION

- For sizing option one
  - ➢You would select and install an HRV/ERV that would meet both TVR and CVR
  - ➢Most product on the market would meet CVR on low speed and TVR on high speed
  - ➢This means that the HRV/ERV would be a larger, higher CFM model
- For sizing option two
  - ➢You would select and install an HRV/ERV that would meet just CVR
  - ➢You would select and install an low 1 sone surface mounted fan (bath fan)
  - ➢The combination of these two device would need to meet TVR
  - ➢This means that the HRV/ERV would be smaller, lower CFM model

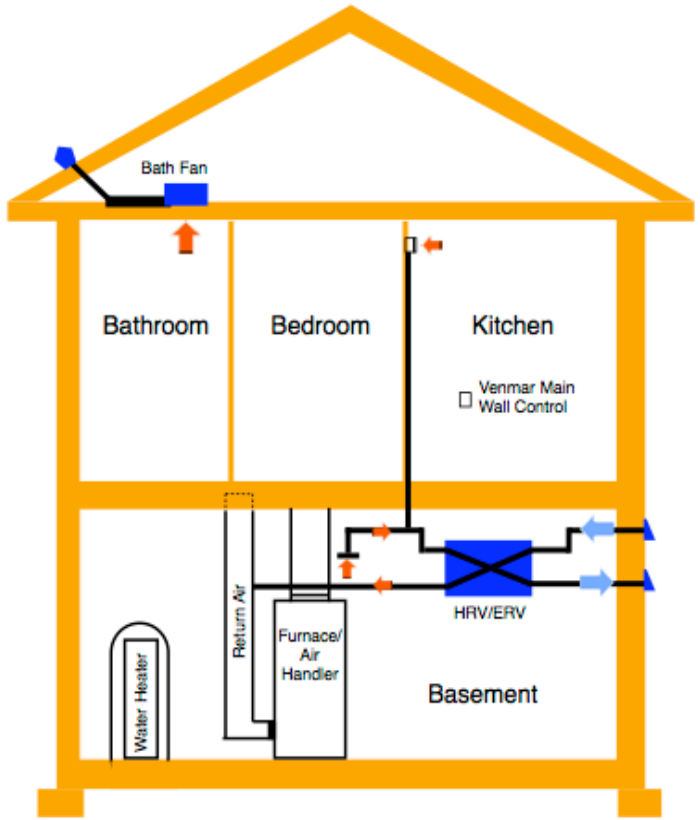
Smaller HRV/ERV

BALANCED - HRV/ERV

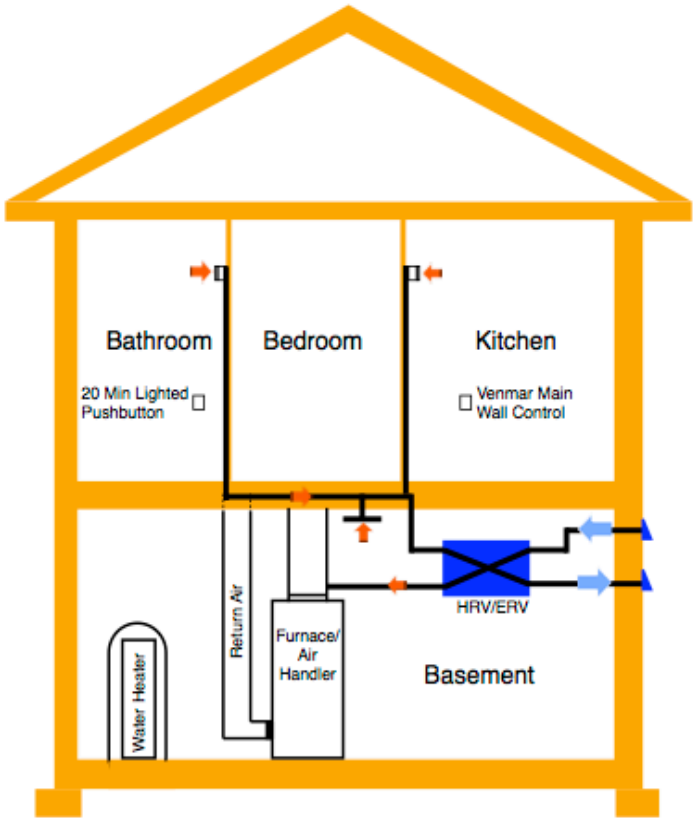
DUCT DESIGN HRV/ERV

- Source point
- General ventilation
- Return- return
- Return- supply
- Fully ducted

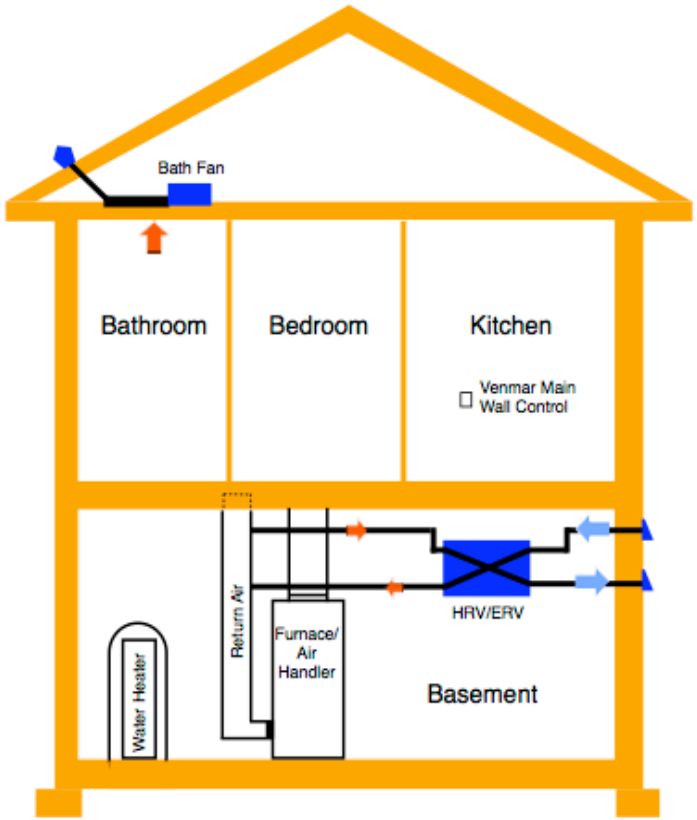
Installation Options



General Ventilation
(one exhaust per level)



Source Point Ventilation



Volume Ventilation
(return/return or return supply)

General Ventilation

- Air is exhausted from the basement (musty smells, moisture) and the kitchen area (moisture, cooking odors, gas stove by-products)
- Tempered fresh Air is ducted to furnace return or supply

Source Point Ventilation

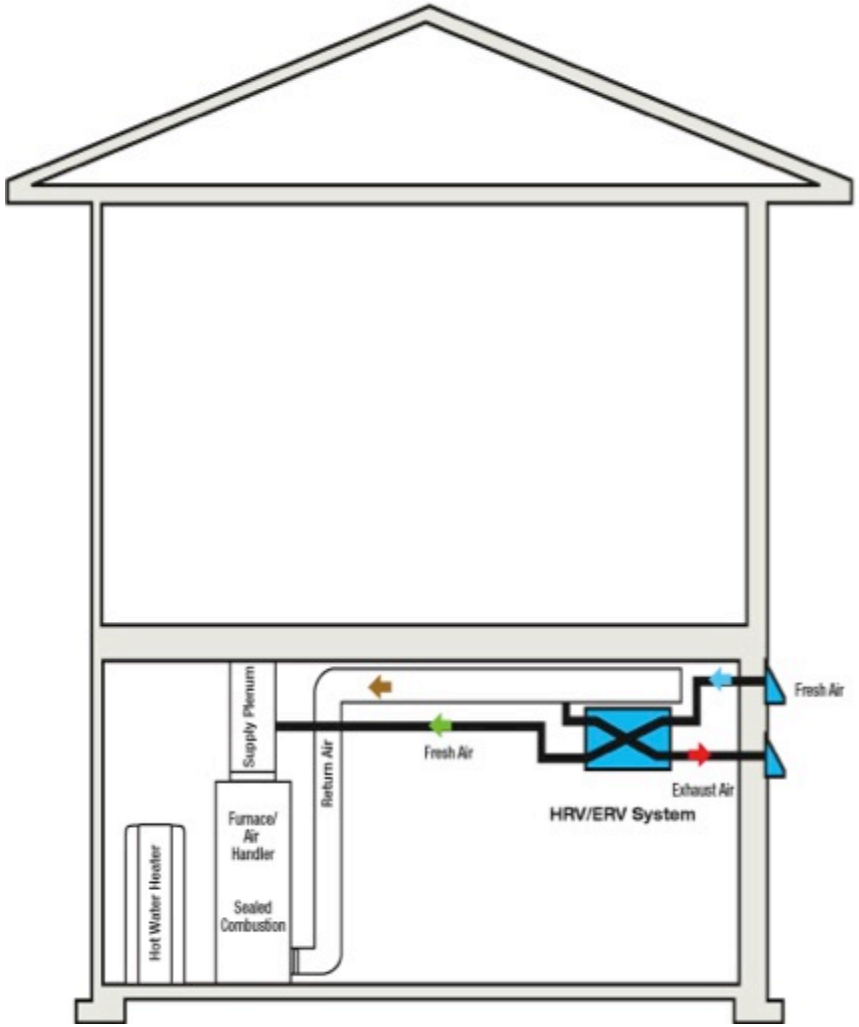
- Air is exhausted from the kitchen area and can replace bathroom fans-- in applications where duct lengths are not excessive.
- Tempered air is ducted to furnace return or supply.

Volume Ventilation

- The existing furnace ductwork is used to exhaust and supply fresh air to the building.
- Tempered air is ducted to furnace return or supply.

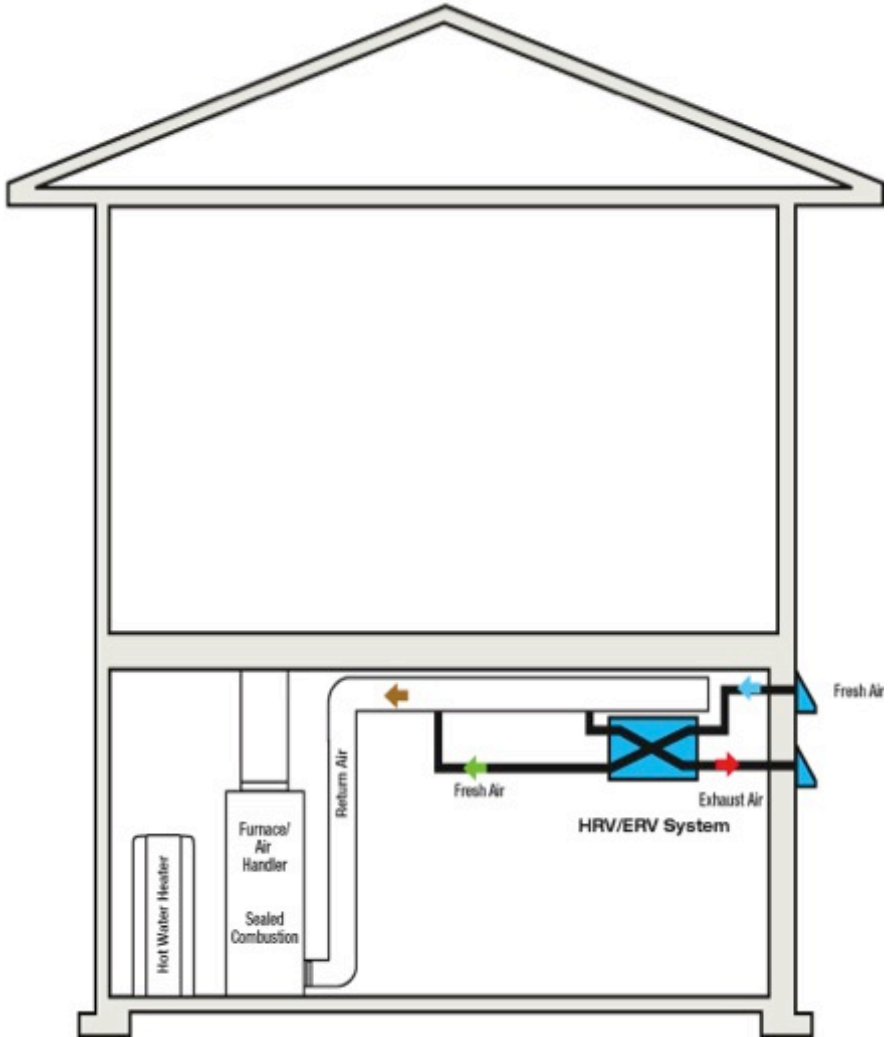
Furnace fan needs to run on a return/return strategy

RETURN – SUPPLY DUCT DESIGN



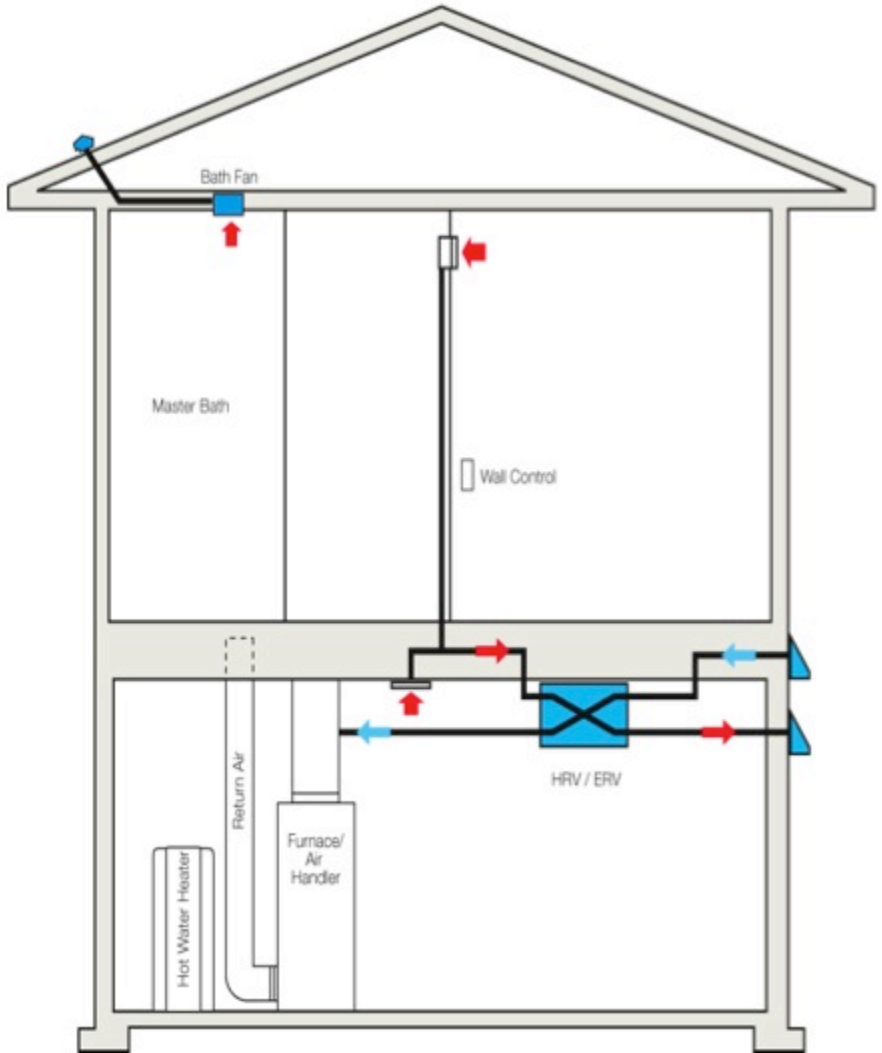
- Great for existing houses
- Air handler doesn't need to run full time
- Simple, quick installation
- Cost effective in new houses
- Most common installation

RETURN-RETURN DUCT DESIGN



- Great for existing houses
- Air handler runs to optimize filtration & fresh air distribution – great for allergy sufferers
- Simple, quick installation
- Cost effective in new houses

GENERAL DUCT DESIGN



- One exhaust point per floor
- Air handler doesn't need to run full time
- Combination of bath fans & HRV/ERV
- Cost effective in new houses

FULLY DUCTED

- For non-forced air heating systems
- Exhaust from bathrooms & kitchen
- Supply to bedrooms & main living areas
- Optimum air quality control

SOURCE POINT DESIGN AND BATH FANS

- DEPENDING ON DUCT LENGTH , TYPE AND SIZE OF THE BATH ROOM

ONE MAY USE HRV/ERV AS BATHROOM EXHAUST SYSTEM… 5 TO 6 ACH. NO BATH FAN NEEDED

- ZONING OF HRV/ERV IS AN OPTION
- AN EXHAUST POINT FROM HRV/ERV AND BATH FAN IN THE SAME BATHROOM IS AN OPTION

DESIGN DETAILS

- THERE IS A LOT OF EXPERIECE AND HISTORY ON HOW SYSTEM ARE INSTALLED ….LOWEST COST IS NOT ALL WAYS THE BEST OPTION , THE INDUSTY IS 30 PLUS YEARS OLD, REVIEW THESE DESIGNS WITH SOME ONE THAT HAS DIRECT EXPERIECE WITH ALL THESE VENTILATION DESIGNS, SIT DOWN WITH AN HVAC PROFESSIONAL AND REVIEW YOUR OPTION FOR THE HOMES THAT YOU ARE BUILDING

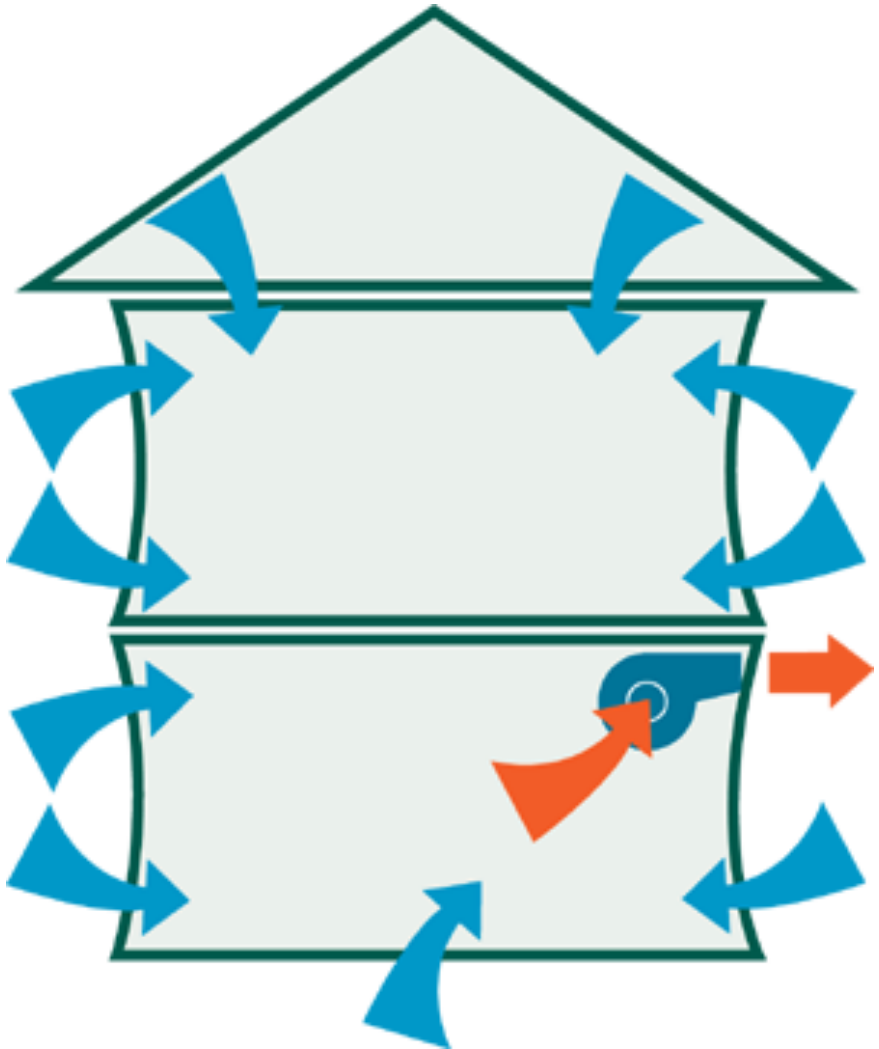
BALANCING R403.5.6.1.3 Airflow Verification

- Greater then 30 cfm
- Consequence if you don’t balance your system
- Building pressure
- Method of testing air flow

WHAT IF SYSTEM IS NOT BALANCED ?

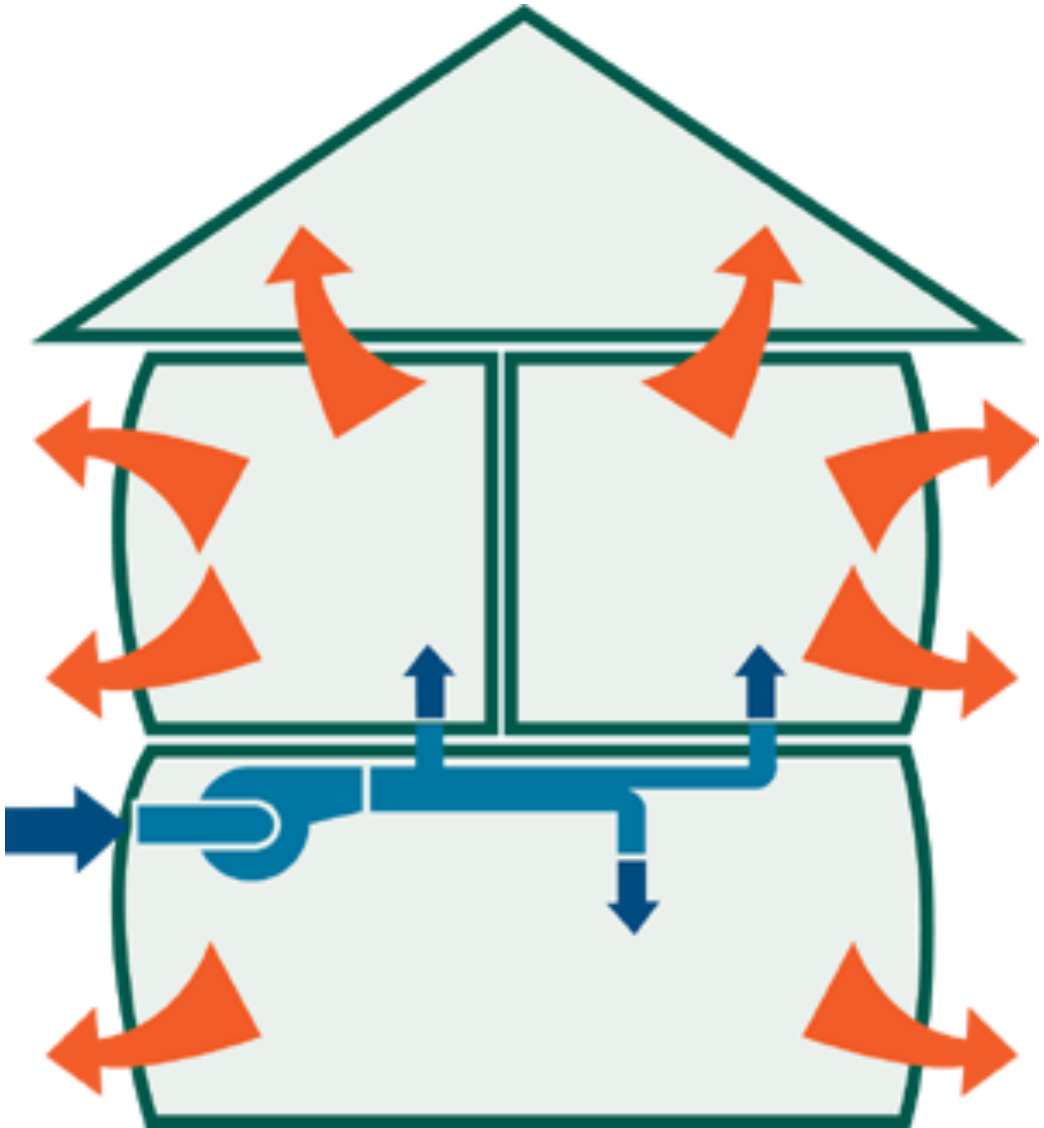
- Comfort complaints, call backs
- Core freeze up and blockage
- Waste of energy
- House can get to dry in winter, to humid in summer
- Building pressure issues

NEGATIVE PRESSURE



- Cold air inflitrates house.
- Increase of energy cost
- Negative pressure may cause combustion exhaust drawbacks.

POSITIVE PRESSURE

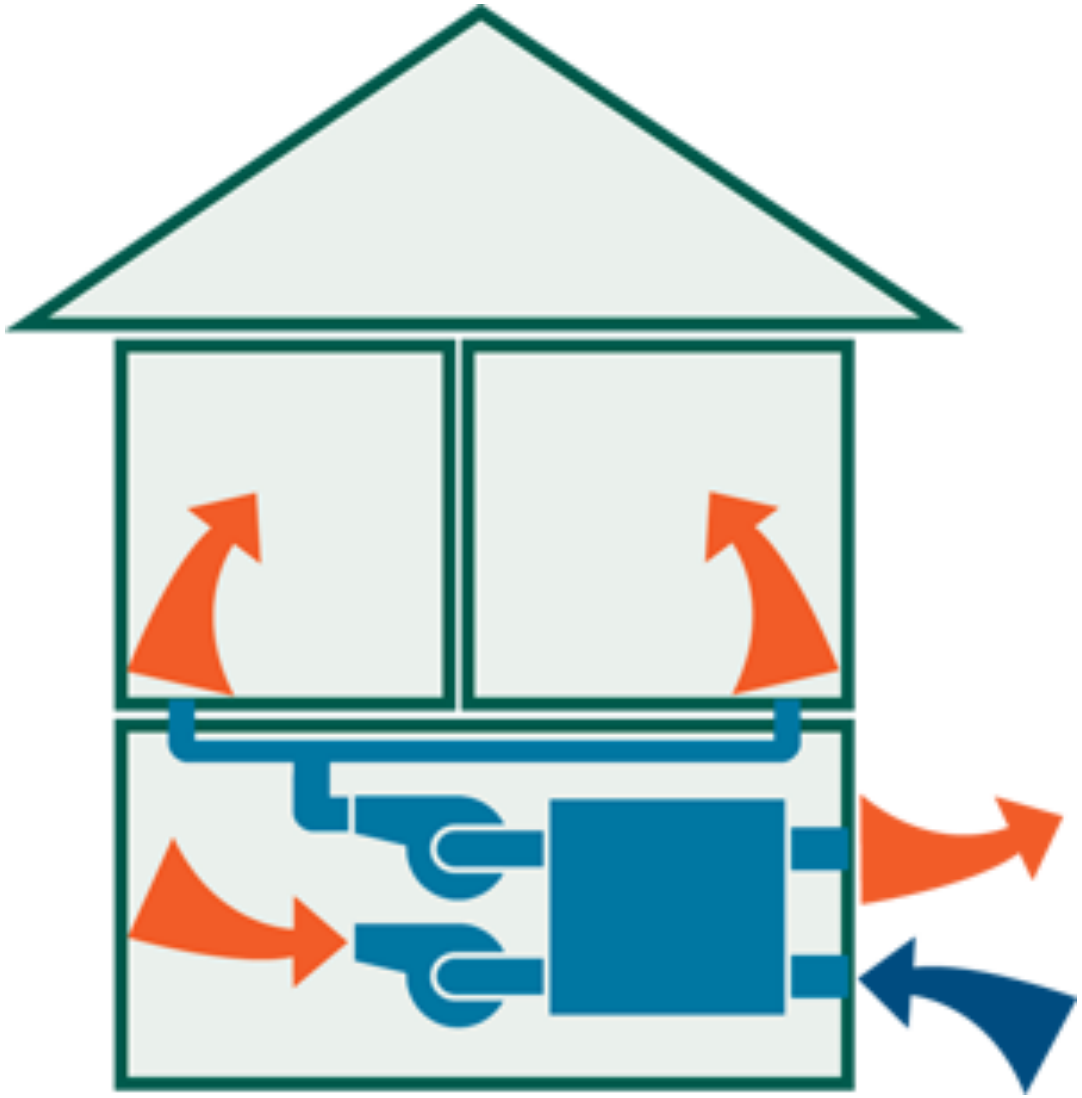


Hot and/or humid air infiltrate walls and condensate on insulation.

Heat loss.

Do not pressurize a house in a cold climate

EQUAL PRESSURE



Balanced

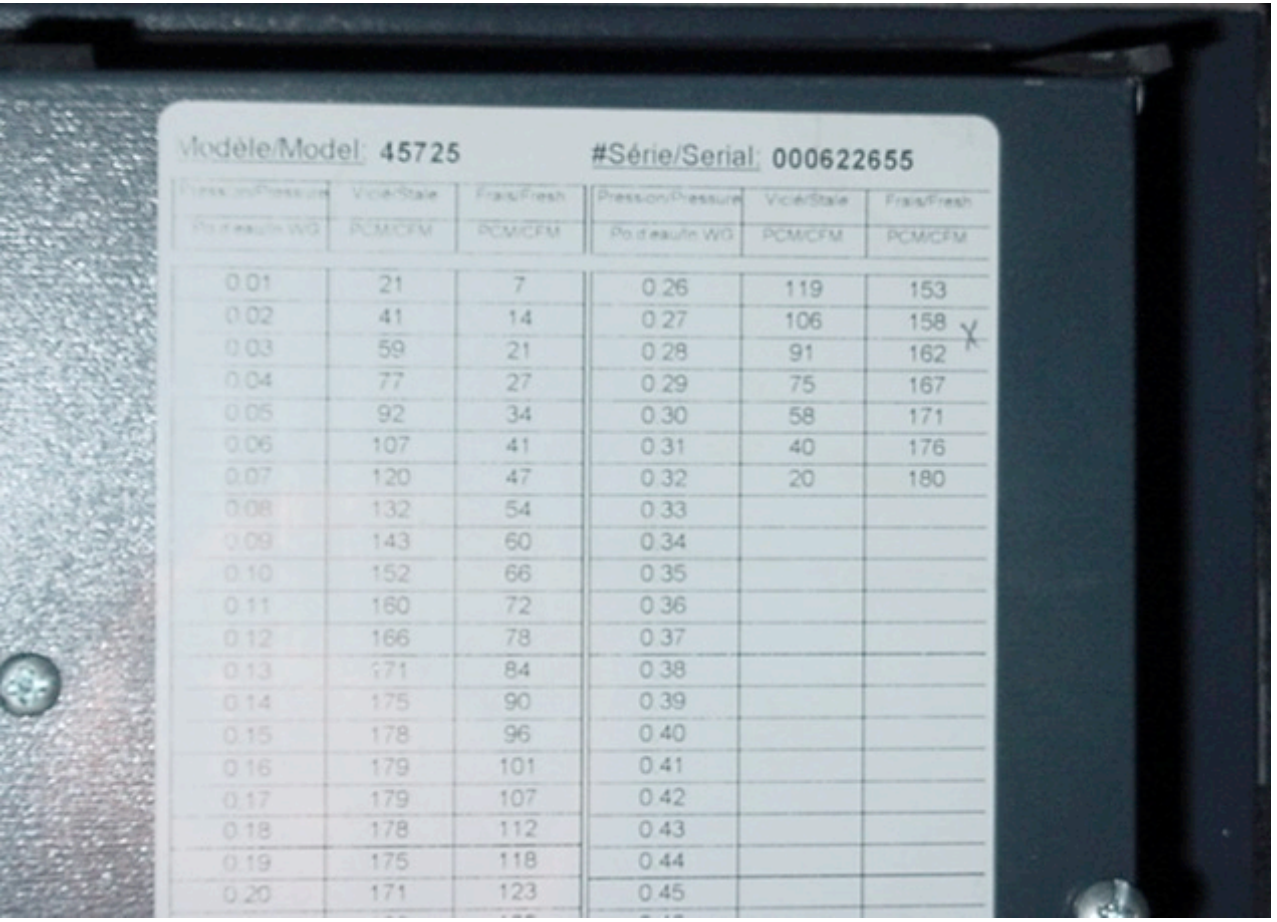
Supply airflow is equal (C.F.M.) to exhaust

Balancing is required to all units

AIR FLOW VERIFICATION

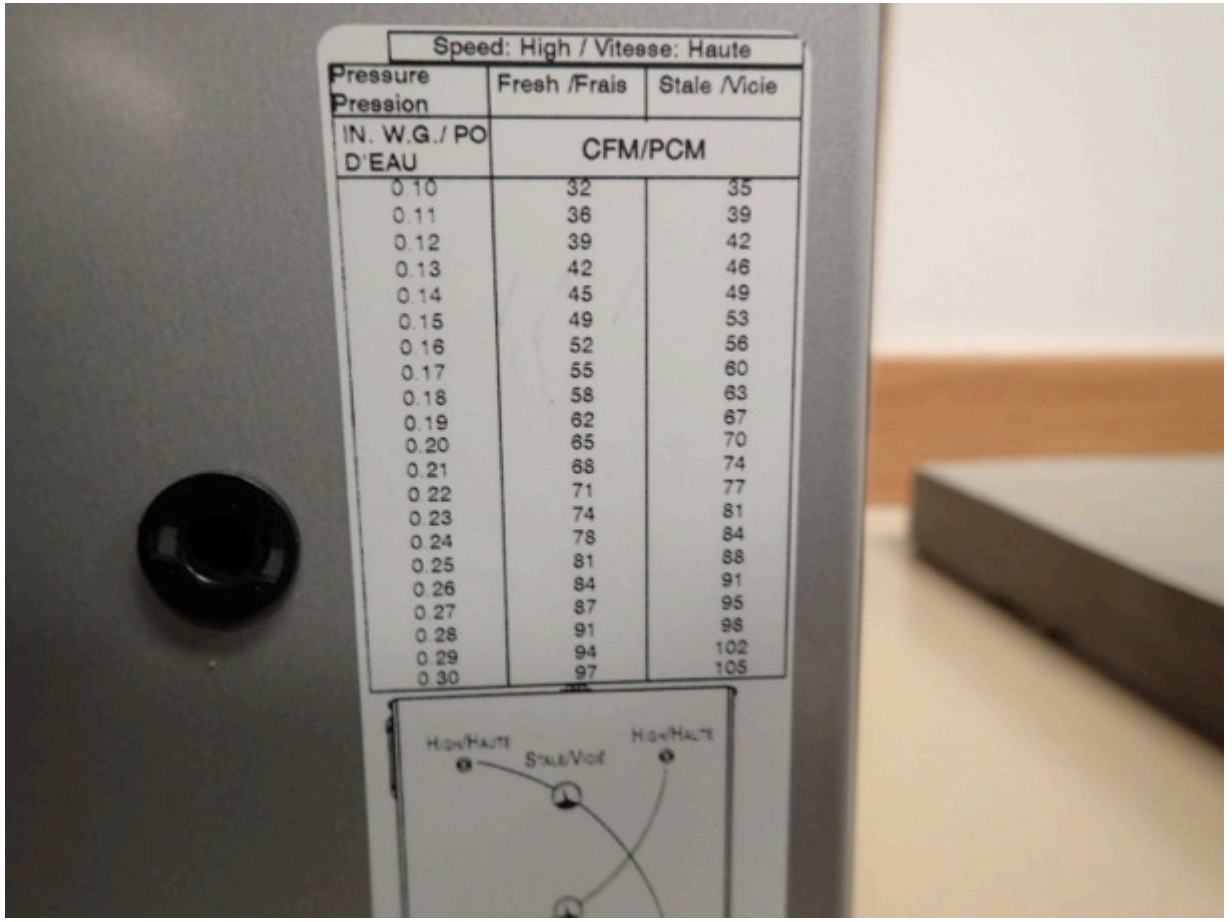
Balancing air flows required by code

BALANCING CHART



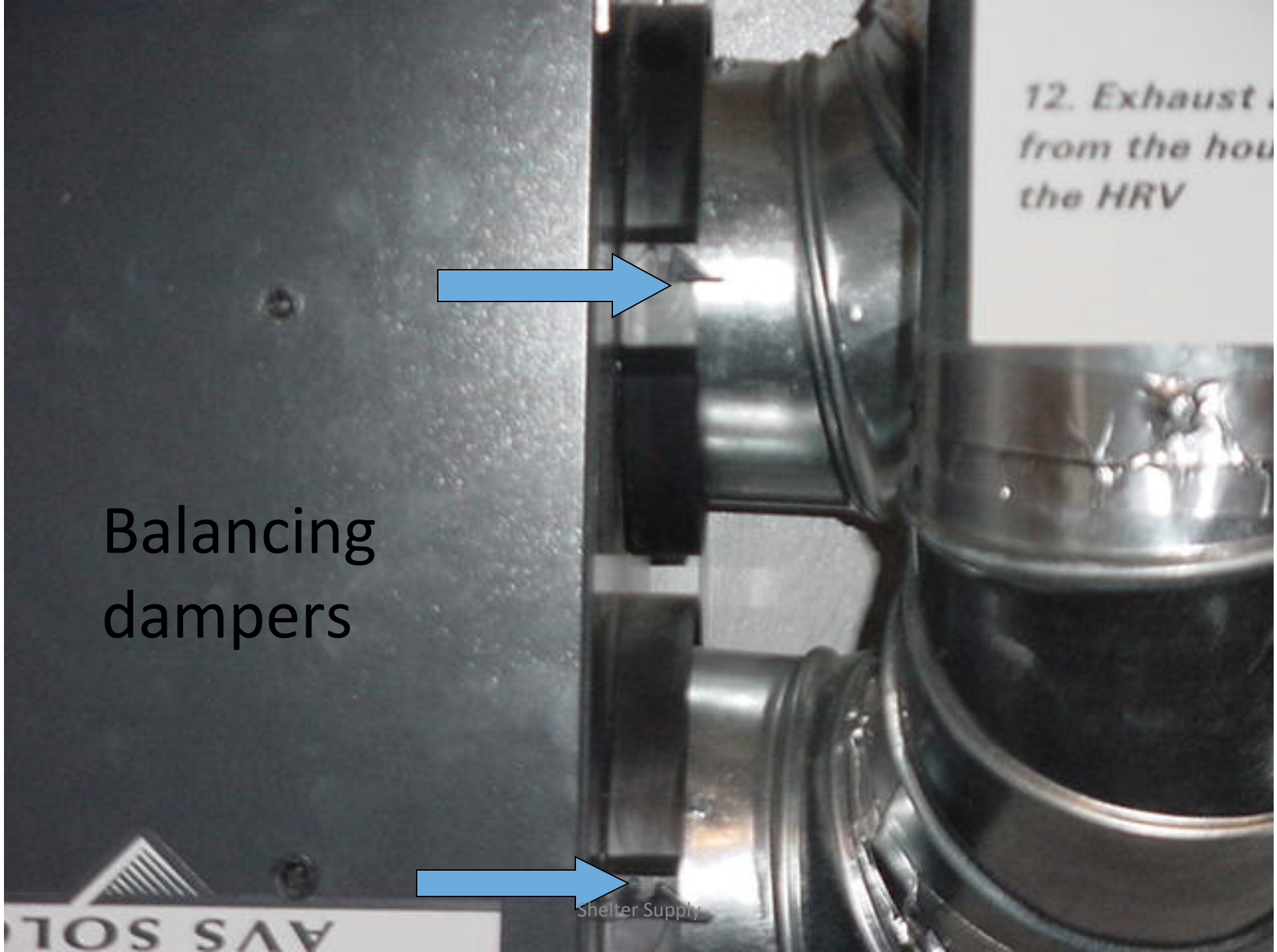
Modèle/Model: 45725 #Série/Serial: 000622655

Pression/Pressure Po d'eau/in WG	Vicié/Stale PCM/CFM	Frais/Fresh PCM/CFM	Pression/Pressure Po d'eau/in WG	Vicié/Stale PCM/CFM	Frais/Fresh PCM/CFM
0.01	21	7	0.26	119	153
0.02	41	14	0.27	106	158
0.03	59	21	0.28	91	162
0.04	77	27	0.29	75	167
0.05	92	34	0.30	58	171
0.06	107	41	0.31	40	176
0.07	120	47	0.32	20	180
0.08	132	54	0.33		
0.09	143	60	0.34		
0.10	152	66	0.35		
0.11	160	72	0.36		
0.12	166	78	0.37		
0.13	171	84	0.38		
0.14	175	90	0.39		
0.15	178	96	0.40		
0.16	179	101	0.41		
0.17	179	107	0.42		
0.18	178	112	0.43		
0.19	175	118	0.44		
0.20	171	123	0.45		



Speed: High / Vitesse: Haute

Pressure Pression	Fresh /Frais	Stale /Vicie
IN. W.G./ PO D'EAU	CFM/PCM	
0.10	32	35
0.11	36	39
0.12	39	42
0.13	42	46
0.14	45	49
0.15	49	53
0.16	52	56
0.17	55	60
0.18	58	63
0.19	62	67
0.20	65	70
0.21	68	74
0.22	71	77
0.23	74	81
0.24	78	84
0.25	81	88
0.26	84	91
0.27	87	95
0.28	91	98
0.29	94	102
0.30	97	105


12. Exhaust
from the hou
the HRV
Balancing
dampers

FLOW STATIONS WITH MAGNEHELIC GAUGE

TESTING CFM ON BATH FAN, FLOW HOOD

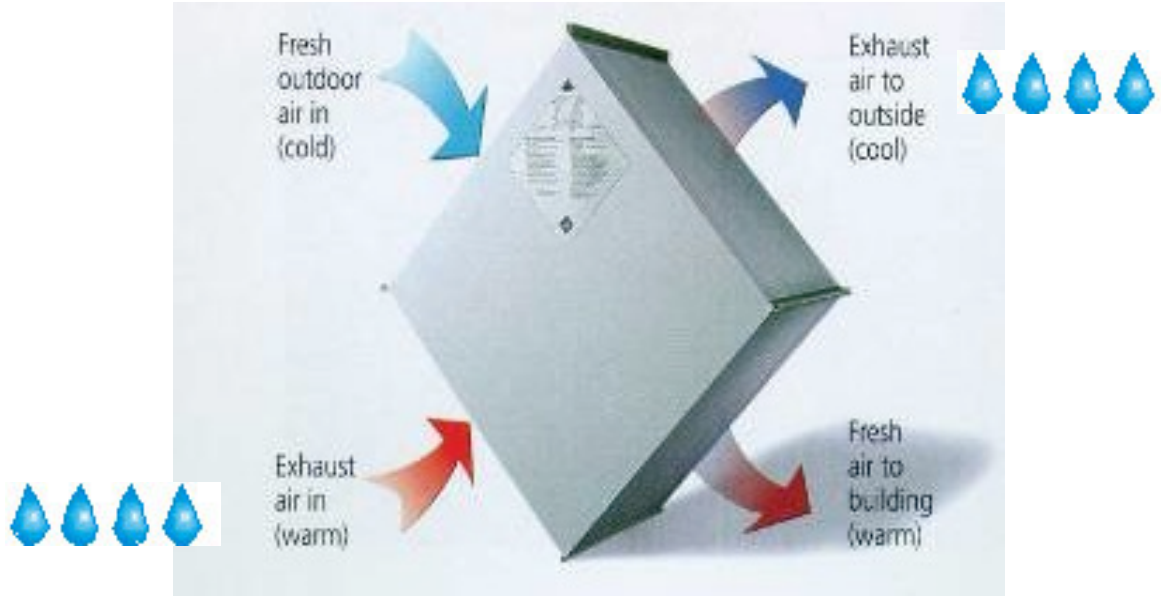
DIFFERENCE BETWEEN HRV AND ERV

- HRV are by far most common type installed units
- HRV is best to reduce window condensation
- ERV will retain more humidity in home in the winter
- ERV will bring in less humidity in summer
- Climate, cost and application is the driving factor on what type is selected

	Climate	Moisture Issues	AC	Allergies/ Respiratory Concerns
HRV	cold	Window condensation	Minimal AC load	Good choice
ERV	warm	Overly dry in winter, humid in summer	High AC load	Best choice

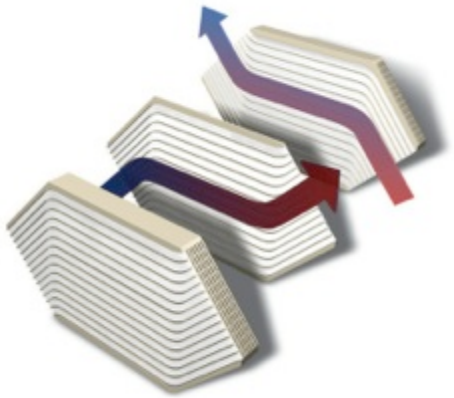
H.R.V. = Heat Recovery Ventilator

- Recovers heat or temperature (sensible)
- Cross-flow core
- Controls excess moisture in winter

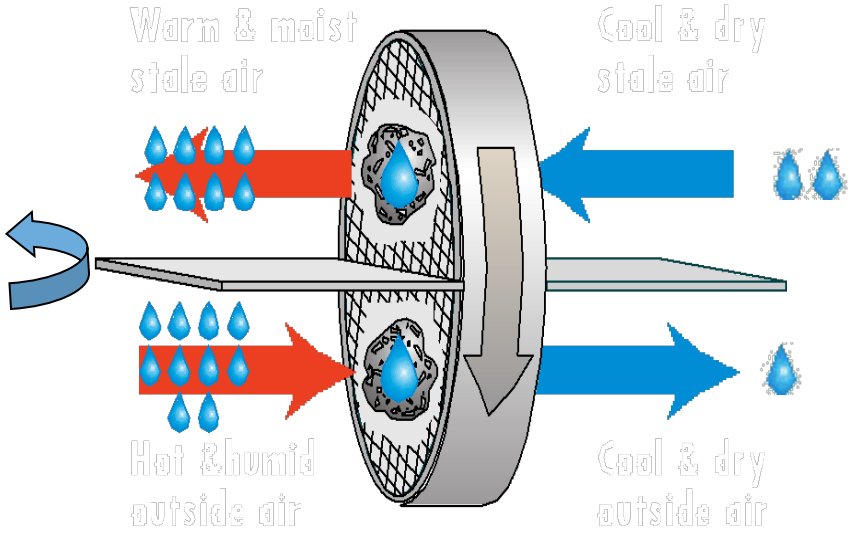


E.R.V. = Energy Recovery Ventilation

- Recovers humidity (latent) and heat (sensible)
- Year round energy efficiency for new & existing homes



Moisture returns outside



Permeable Core or Wheel

HUMIDITY IN WINTER

Understand what is the relationship between the ventilation strategy and how to humidify the home in the cold weather months

Condensation

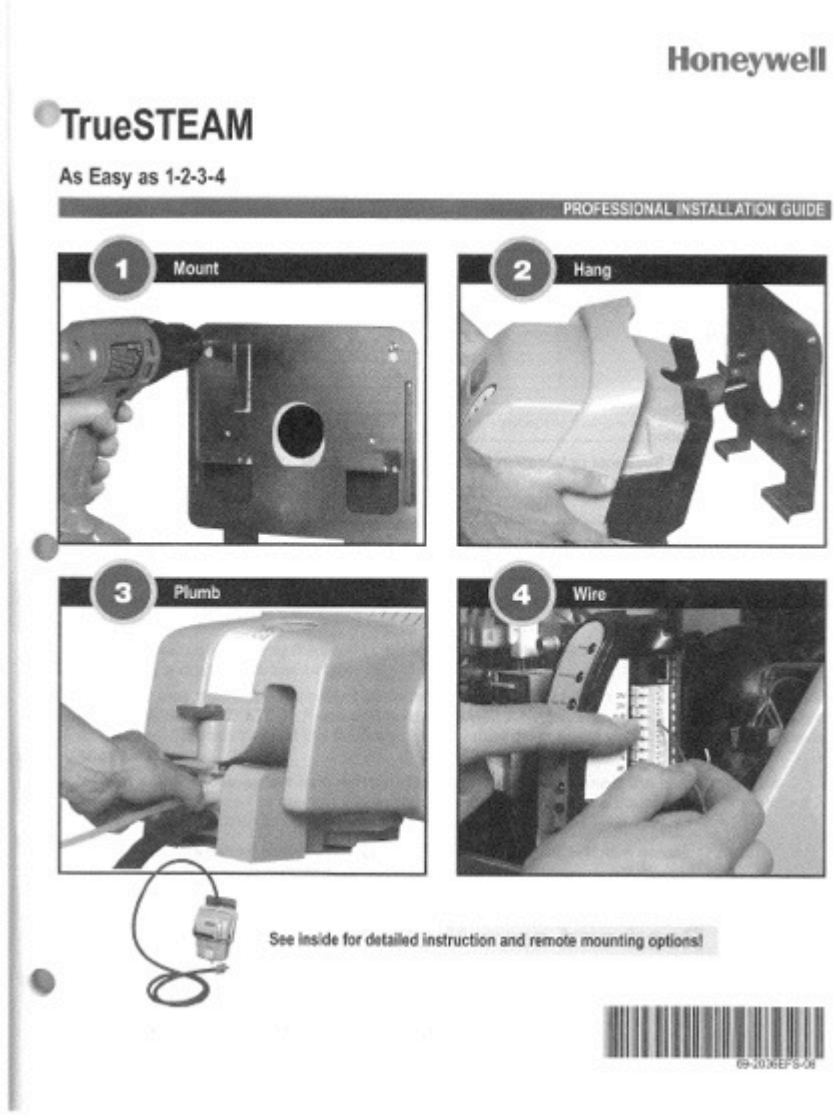
- LIFESTYLE ?
- VENTILATION ?
- HUMIDIFIER OPERATION ?
- TEMP. OUTSIDE AND INSIDE ?
- RH% RELATIVE HUMIDITY?


TEMPERATURE
71.4°F
AM
12:00
39%
CLOCK / HUMIDITY
MODE
ADJ
MEMORY
Desert Spring® Products

Humidity gauge a must !

BYPASS STYLE WITH AUTO CONTROL

STEAM HUMIDIFIER



New Control Systems

- Temperature Compensating Humidity Controls - Automatically adjust humidity set point based on changing outdoor conditions
  - Ideal humidity level in the winter is as high as you can keep it without causing moisture on the windows
  - With manual humidistats, the humidity is always too high, causing moisture damage, or too low, causing discomfort

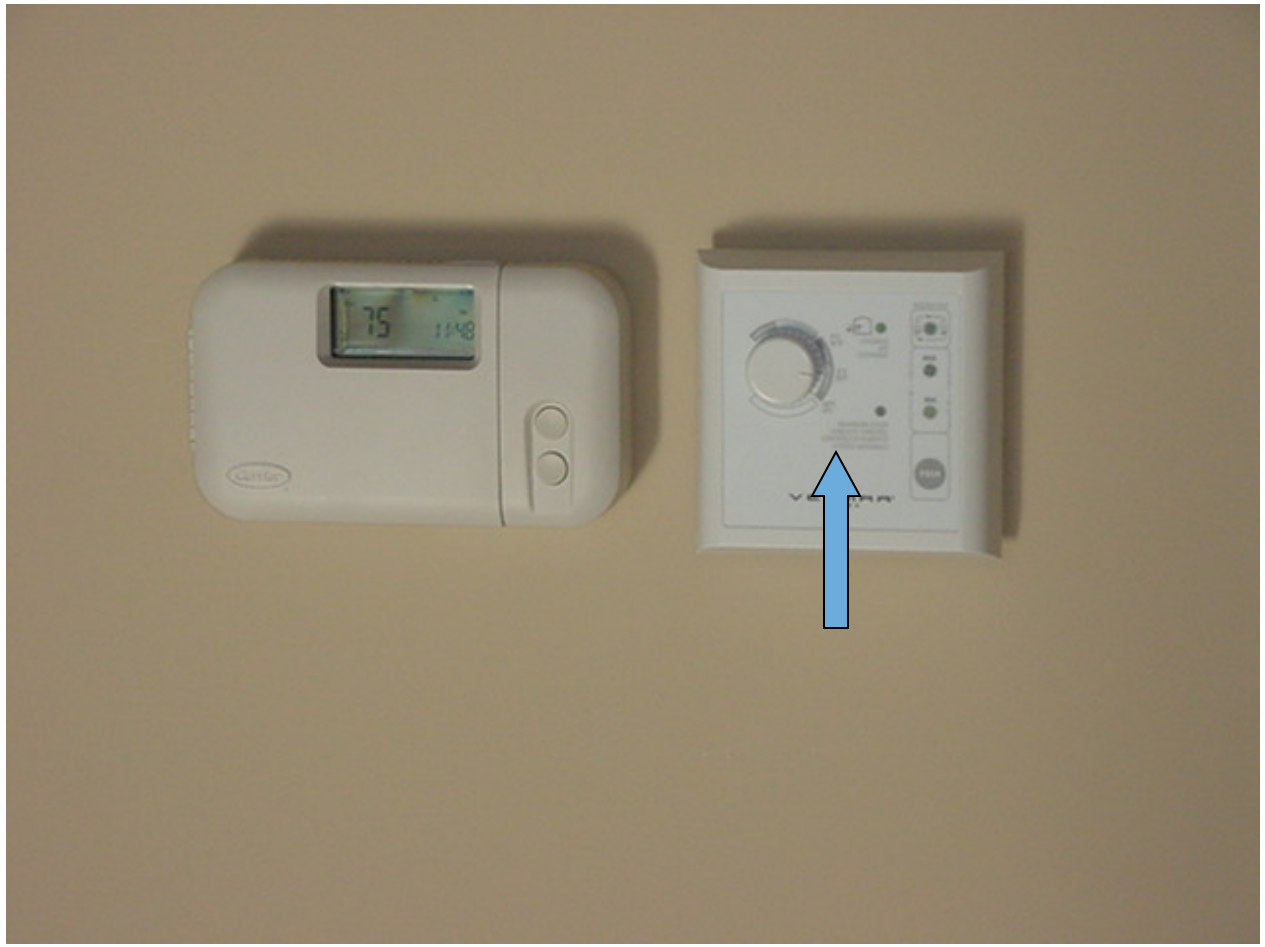
Dust (particles) and Gases

CONTROLS

Integrated control and quick wiring connect

SIMPLE PUSH BUTTON WITH SOME GRAPHICS

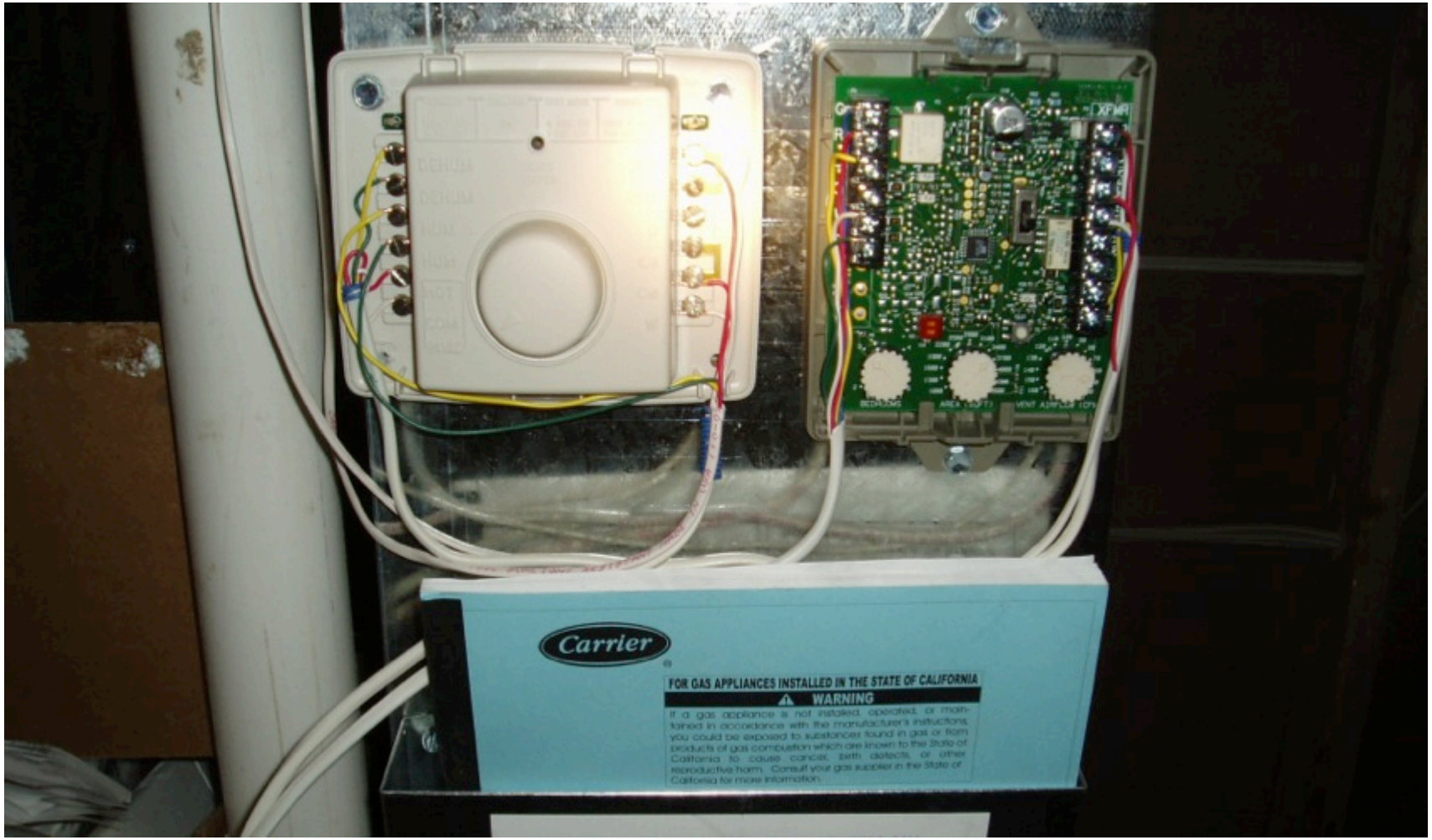
T –stat and Ventilation control



ADVANCED CONTROLS

Bath room switch, high speed override

NEW VENTILATION CONTROLS, can be confusing



MAINTENANCE

- General guide lines

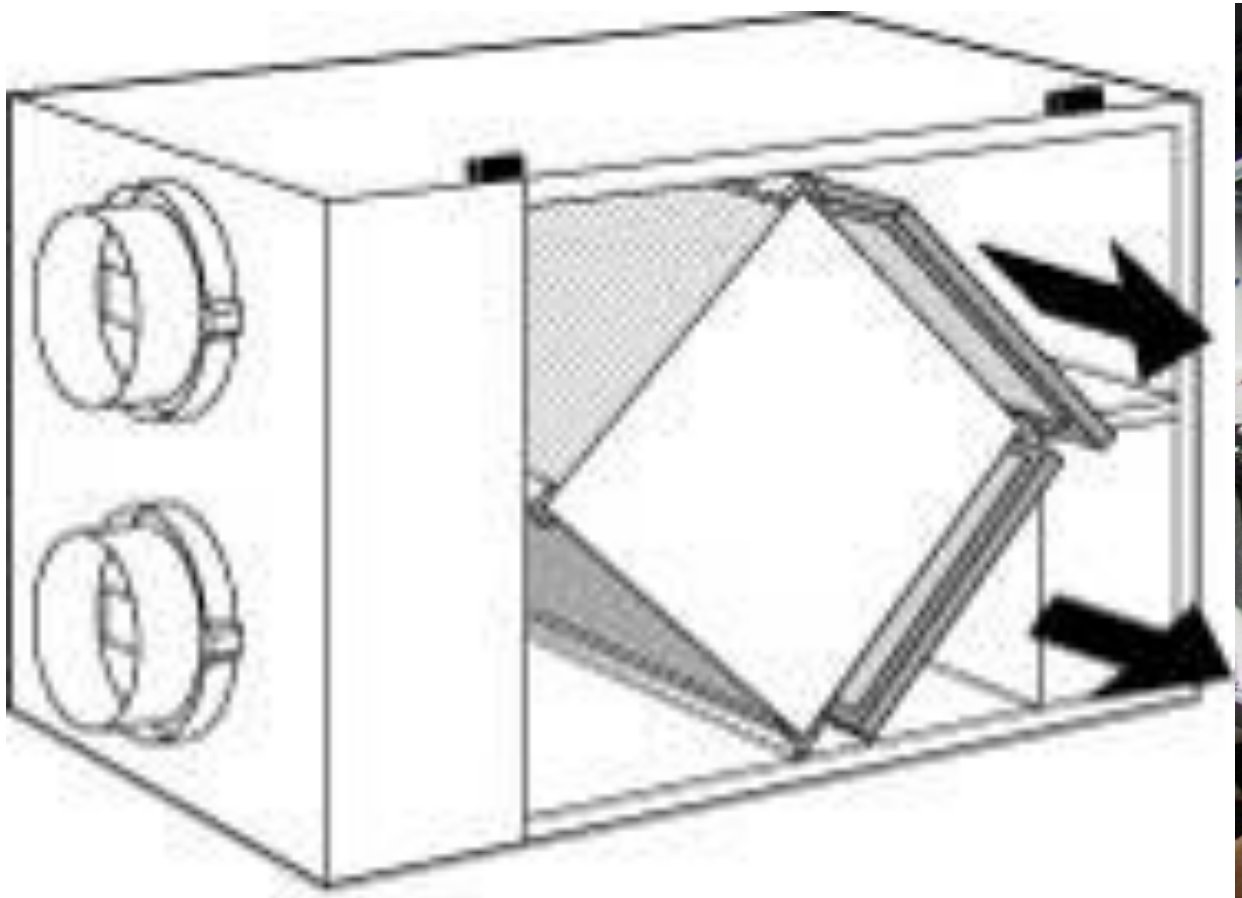
Every 2-3 months

- Check and clean filters

Once per year

- Clean HRV/ERV cores
- Clean intake vents, grilles, hoods
- Check operation of dampers / controls

FILTERS



Air intake needs to be cleaned

TO CLOSE TO GRADE

Explain to the homeowner… how it works and maintenance

Thank you for your time

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