

Evaluating & Applying the ASHRAE 62.2-2010 Residential Ventilation Standard

Paul Raymer, Heyoka Solutions
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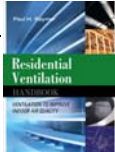
What We Will Talk About

- Review the system documentation and determine compliance with the ASHRAE 62.2-2010 Standard (Replaced in many locations by the 2013 version, but most of the basic requirements haven't changed);
- Identify the ventilation components;
- Review the installation and resolve issues;
- Test the system to confirm operation;
- Advise the homeowner on system maintenance.



Who We Are

- Paul H. Raymer
 - Chief Investigator of Heyoka Solutions – trainer, writer and developer of ventilation options
 - Author of the Residential Ventilation Handbook
 - Secretary of the 62.2 committee



62.2: What is it?

- Single family, multifamily up to three stories, and manufactured and modular buildings;
- Considers chemical, physical, and biological contaminants but **does not consider thermal comfort**;
- Acceptable IAQ will not necessarily be achieved even if all requirements are met.



Who We Are

- Paul Francisco
 - Research Engineer at Indoor Climate Research & Training, Illinois Sustainable Technology Institute, University of Illinois
 - Technical Director for the U of I Weatherization Training Center (DOE-funded)
 - Chair of the 62.2 committee



Why do we want fresh air?

- Many indoor contaminants
 - Carbon monoxide, carbon dioxide, VOCs, formaldehyde, radon, (sometimes) moisture, particles, oxides of nitrogen, etc.
 - Not necessarily at acute levels, but there is substantial evidence that low levels of many pollutants can impair quality of life





Ventilation Rule 3

Moving air will always seek the path of least resistance.

"Air is like crooked rivers, crooked people, teenagers, and cheap labor." John Tooley (Advanced Energy)

Ventilation Rule 1

One cubic foot of air (cfm) moves into a house only if one cubic foot of air moves out of the house.

1cfm in = 1 cfm out

62.2: What is it? Here it is in a nutshell!

- Select a whole building airflow from the table (or calculate it);
- Select appropriate airflow rates for local exhaust;
- Select quiet equipment whose performance is certified by HVI;
- Install it so it works;
- Test it to prove that it works.

"How hard can it be?"
Edward Brannock, Pilot & Entrepreneur

Ventilation Rule 2

Air always flows from higher pressure to lower pressure.

(Second Law of Thermodynamics)

ASHRAE 62.2 Requirements

- Whole building ventilation:
 - "A mechanical exhaust system, supply system, or combination thereof shall be installed for each dwelling unit to provide whole-building ventilation. . ."
 - Ventilation based on the equation or table.
 - These CFM requirements are for whole building continuous ventilation

Source: ASHRAE 62.2-2010, page 4

Whole Building Ventilation System Types

- System types:
 - Exhaust-only;
 - Supply-only;
 - Balanced system;
 - Balanced system with heat or energy recovery
 - HRV (sensible heat recovery)
 - ERV (sensible and latent heat recovery)

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System Choices – Exhaust fans

Bath fans. Should be certified by HVI for both air flow and sound.

Ceiling insert

Through wall

HVI CERTIFIED

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Exhaust-Only

- Most common ventilation system;
- Relies on leakage to make up the exhaust air;
- Could be a single fan exhausting from a single point like a bath fan.

Source: 62.2 User's Manual ©2006 ASHRAE

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System Choices Exhaust Only

Panasonic Whispergreen NuTone Ultra Series Air King

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Bathroom or Hall Exhaust Fans

The grille could be disguised as a recessed light.

Photos courtesy of Wisconsin Weatherization Program

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System Choices Exhaust Only

Panasonic

WhisperGreenSelect Panasonic

1 Fan54 IAQ Solutions

Six WhisperGreen Select Base Models:


- FV-05-11VKSL: 130 to 110 CFM integrated multi-speed + LED Light
- FV-05-11VKL1: 50-80-110 CFM single speed + LED Light
- FV-05-11VKS1: 30 to 110 CFM integrated multi-speed
- FV-05-11VK1: 50-80-110 CFM single speed
- FV-11-15VK1: 110-130-150 CFM single speed
- FV-11-15VKL1: 110-130-150 CFM single speed + LED Light


- Customizable, all-in-one fan and fan/LED light combinations
- Pick-A-Flow speed selector satisfies designed air flow
- Plug 'N Play technology provides up to three value added features
- Revolutionary DC motor with SmartFlow™ technology

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System Choices Exhaust Only

Broan/NuTone






110 CFM
ULTRASense™ H, Humidity Sensing
Technology fans react to a quick rise
in humidity to turn the fan on;
ULTRASilent™ Sound Technology
less than 0.3 Sones;

Power: 8.3 Watts

NuTone Ultra Series SB110H


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System Choices Exhaust Only

Delta Breez





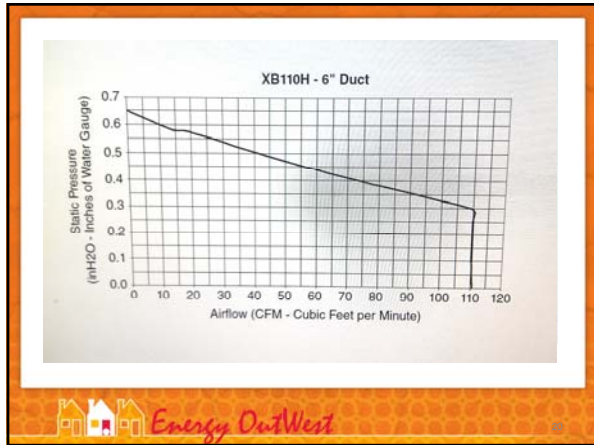

High Efficiency DC Motor
Lock protection
Adjustable switch
LED indicator
Humidity sensor
Thermal protector
Duct clamping rubber reducer
Wash door clipper
Plug in design

CFM: 50 to 124
Sones < 0.3
Power: 5.6 to 20 watts
Humidity control





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System Choices Exhaust Only

Fantech





FQ80L
Sones: 0.4
Power: 30 watts
Light: 26/4

FQ80
Sones: < 0.3
Power: 25 watts


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System Choices Exhaust Only

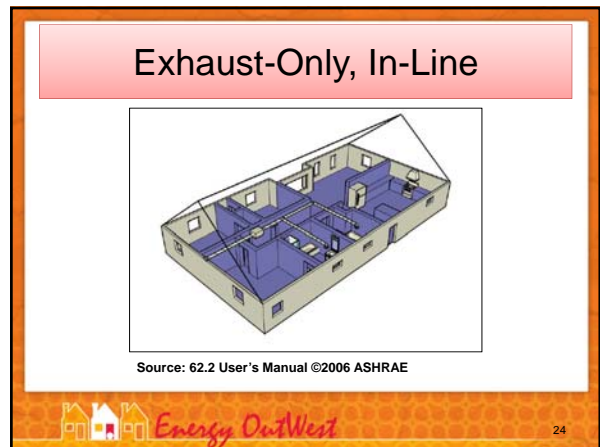
Air King



- Model ESVD;
- 2 set up speeds;
 - Low 30, 40, 50, 60, 70, 90, 100, 120
 - High: 80, 110, 130, & 150
- Optional 26w night light;
- Optional motion sensor;
- Optional humidity sensor;
- All airflow below 130 cfm < 0.3 sones




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System choices – in-line fans

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Supply-Only

Supply-only Air

Supply Air Fan

©Residential Ventilation Handbook, McGraw-Hill, Raymer 2009

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In-line Exhaust Fans

Photos courtesy of Wisconsin Weatherization Program

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Supply-Only Dedicated Systems

Supply air systems including duct connections and filters and flow regulators

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In-Line Exhaust Fans

Motion sensing grille

In-line fan with lighted grilles

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Supply-Only Dehumidification


Recommended Attic Install

Dehumidifying supply air system from Thermo-stor

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Supply Ventilation to Furnace Return Air

- Ducts must be tight (or they can bring in bad air);
- Must have good motorized damper;
- Must be controlled to run even if no heat is needed;
- Furnace fan energy use can be high;
- Intake must be kept clean of yard debris and other outdoor stuff.



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Supply Ventilation to Furnace Return Air

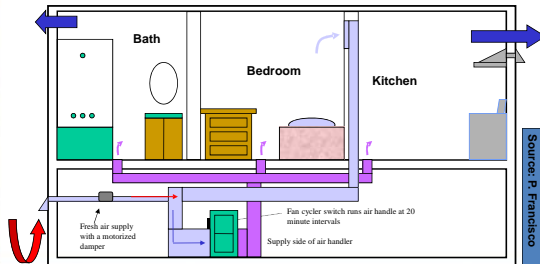


Photos: P. Francisco




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Supply Ventilation to Furnace Return Air




Source: P. Francisco



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Balanced Ventilation

- Exhaust and supply ventilation should have equal cfm.
 - Balanced without recovery
 - unit transfers sensible heat only with no humidity transfer.
 - Heat Recovery Ventilator (HRV)
 - unit transfers sensible heat only with no humidity transfer.
 - Energy Recovery Ventilator (ERV)
 - Unit transfers sensible heat and humidity.



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Supply-Only Furnace return

Outside air supplied to return side of the air handler



Aldes CAR

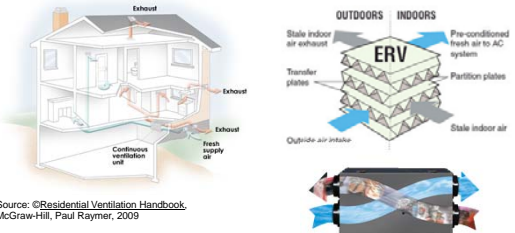
AirCycler

Field Controls Damper




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Balanced with heat or energy recovery Dedicated ducting



Source: ©Residential Ventilation Handbook, McGraw-Hill, Paul Raymer, 2009



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Balanced Ventilation HRV/ERV

Illustrates connection to the existing HVAC system

Source: 62.2 User's Manual ©2006 ASHRAE

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Heat Recovery Ventilators (HRV)

Must be installed in an accessible place for service.
Should be inside the conditioned space for maximum efficiency.

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Primary System Design Choices – Balanced with heat or energy recovery

2nd Law of Thermodynamics – Heat moves to cold, wet moves to dry

Heat Recovery Ventilator (HRV) transfers heat from the warm air stream to the cool air stream.

Energy Recovery Ventilator (ERV) transfers sensible and latent heat from warm, moist air stream to the cool, dry air stream.

Desiccant wheel ERV

Energy OutWest

Primary System Design Choices – Balanced with heat or energy recovery

Different efficiency ratings for HRVs and ERVs

Sensible Recovery Efficiency (SRE) is the number that defines the "sensible energy recovered minus the supply fan energy and preheat coil energy, divided by the sensible energy exhausted plus the exhaust fan energy. This calculation corrects for the effects of cross-leakage, purchased energy for fan and controls, as well as defrost systems."

Generic Specifications	64-146	108-235
CFM at low-high speed		
Apparent sensible effectiveness at 0°C	83 %	77 %
Warranty on components	5 years	5
Warranty on the core	Lifetime	Lifetime

Single room ERV

This info is available on the HVI certification sheet.

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Heat Recovery Ventilators (HRV)

Venmar HRV, inside view

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Controls

ASHRAE 62.2-2010 requires that the occupant have the ability to shut the system off.

Intermittent operation requires a timer or other control.


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Controls

For blower door testing, the ventilation system needs to be turned off.

Some controls are multiple speed. Whole building ventilation is generally set to the lower flow.

Both lower and higher flow rates should be tested.



Controls




Tamarack Technologies, Inc. Fantech Panasonic




Controls

Whole Building Ventilation

- o Complies with 62.2-2010;
- o “appropriately labeled”;
- o “readily accessible”.
- o But if installed in an obvious place, is likely to be turned off.



Source: Residential Ventilation Handbook, McGraw-Hill, Paul Ruppert, 2009




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Local Exhaust

Rates

	Intermittent	Continuous
Kitchen	100 cfm Vented range hood required if exhaust fan flow rate is less than 5 kitchen ACH	5 ACH
Bathroom	50 cfm	20 cfm




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Controls

Whole Building Ventilation


Control alternatives:

- o “appropriately labeled”;
- o “readily accessible”
- o Both of these controls require circuit breaker or system override to shut off.



Honeywell
Will require reprogramming after shut down.


AirCycler



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Local Exhaust – Appendix A


- For existing dwellings only.
- Provides alternative method of meeting local exhaust requirements in kitchens and bathrooms:
 - That do not have any existing LOCAL fan, or
 - Where the LOCAL fans do not meet the CFM requirement.



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Infiltration Credit



- Based on blower door result
- Makes use of height of building and local weather



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Install it so it works.


- Air is lazy;
- Electrons are more forgiving;
- Never use “duck” tape;
- Always choose the shortest, straightest path to the outside;
- System must be serviceable;
- Never, never, never vent into the attic.

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Overall ventilation rate

- Increase to account for local exhaust shortages
- Possible decrease for infiltration greater than assumed by 62.2



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Install it so it works.

- In-line fans are designed to drag air through ducts;
- Propeller or axial fans are not good for ducts;
- Backdraft dampers can cut the airflow in half.







©Residential Ventilation Handbook, McGraw-Hill, Paul Raymer, 2009





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Select the Equipment

Whole Building Ventilation - Type

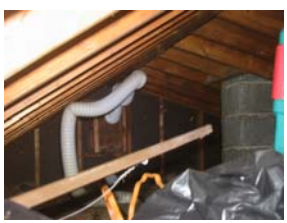

- Select equipment with performance certified by AMCA or HVI;
- Very quiet: 1 sone or less.
- Exhaust or Supply only ventilation;
- Mechanically balanced ventilation;
- Mechanically balanced ventilation with heat or energy recovery.

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Install it so it works.

Really?

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Install it so it works.

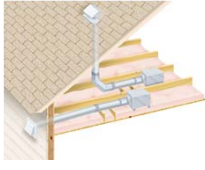
Design it right

The effects of duct length on airflow performance in more detail.

Actual length is the actual, physical length of the duct run (how far it is from A to B);


Equivalent length is equivalent resistance to the airflow generated by the fittings;

Effective length is the sum of the Actual and Equivalent lengths.

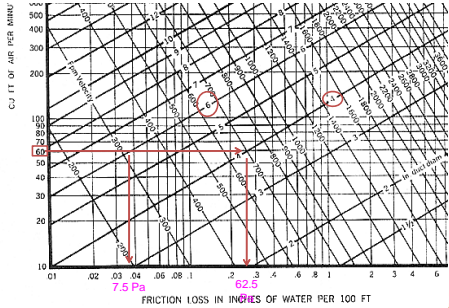


Source: Residential Ventilation Handbook, McGraw-Hill, Paul Raymer, 2009


Actual length + Equivalent length = Effective length



Install it so it works.










Increasing the duct diameter from 4" to 6" will dramatically reduce the friction loss.



Install it so it works.

Equivalent Lengths

	Description	Equivalent Length (Ft) for rigid ducting	
	45° adjustable elbow, 2-piece	5	From Residential Ventilation Handbook
	90° adjustable elbow, 4-piece	10	
	Wye, equal sizes	10	
	Tee, take-off	50	
	Tapered increaser/reducer	4	
	Hard increaser/reducer	8	










Install it so it works.




Photos: Paul Raymer



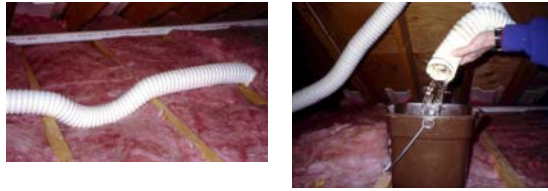
Install it so it works.

	Description	Equivalent Length (Ft)
	Triangular wall cap for round duct with backdraft damper & bird screen	60
	Triangular wall cap for round duct with bird screen, without backdraft damper	35
	Rounded wall cap for round duct with backdraft damper & bird screen	40
	Louvered wall cap	40
	Low profile soffit vent with backdraft damper and bird screen	60
	Roof cap, low-profile for round duct with backdraft damper & bird screen	60
	Roof cap, 'goose-neck', for round duct with backdraft damper & bird screen	35

From Residential Ventilation Handbook




Install it so it works.



Photos: Paul Raymer

Water reduces the diameter of the duct; Air flowing across water creates waves, increasing the resistance.



Install it so it works.

Photos: Paul Raymer

System Design Choices – System distribution

- Inexpensive to install but marginally effective and expensive to operate.
- Both systems have to run simultaneously;
- Stale air is not removed at polluting locations;
- Very difficult to balance.

Air handler return
 "Stale" air from house
 Fresh air to house
 HRV

Terminations Gone Wrong

Don't do this!

Photos: P. Francisco

System Design Choices – System distribution

Well filtered HRV installation
<http://www.ventsolutionsfbx.com/home>
 Beautiful installations!
 Ventilation Solutions Fairbanks, AK

Results of Bad Terminations

Different attics

Test the airflow

"In theory, everything works in practice. In practice, it's different."

Yogi Berra

Airflow Testing (or How do you know it really works?)

Simple stuff – CMHC “Calibrated Garbage Bag”:

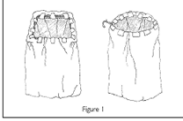
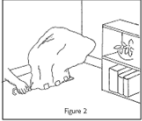




Figure 1 Figure 2

http://www.cmhc-schl.gc.ca/en/co/maho/yohoyohe/inaiqu/inaiqu_003.cfm



Test the airflow






FlowFinder TSI Dwyer Kele



Airflow Testing (or How do you know it really works?)

Simple stuff – CMHC “Calibrated Garbage Bag”:



Time to deflate small “green” bag (Glad 66 x 91 cm)	CFM
1 second	50 cfm
5 seconds	30 cfm
12 – 13 seconds	10 cfm




Test the airflow TEC Exhaust fan flow meter

Jumping the inputs between the channels allows both the pressure and CFM to be monitored.

If the flow exceeds 124 cfm, a different device must be used.






Paul Raymer





Test the airflow

A Balometer will measure flows between 10 and 500 cfm.

Photos: Paul Raymer

Vane anemometer is less effected by ambient conditions like temperature, humidity and altitude. Accurate between 0 and 75 cfm.

Test the airflow





Duct Blaster with DG700 Flow Blaster with DG700 Paul Raymer Q241 Duc-Tester with DM-32 gauge



Test the airflow

Fan Under Test Calibrated Duct Tester

Point A

When the pressure at Point A = 0 pa, the flow through the Duct Tester fan = the flow through the fan under test.

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Adjacent Spaces

“Measures shall be taken to minimize air movement across envelope components separating dwelling units, and to dwelling units from garages, unconditioned crawl spaces, and unconditioned attics.”

Ventilation air needs to come from outdoors.

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Test the airflow

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Adjacent spaces

Parking in the living room!

Photos: Paul Raymer

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Other requirements

Just a few other things

- Basically you're done. But you do need to consider . . .

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Adjacent spaces


Parking in the living room!

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Combustion safety

- Tightening houses increases the risk of back drafting. Increasingly important to test for problems
 - Worst-case conditions
 - Spillage (natural draft appliances)
 - CO (all combustion appliances)



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Maintenance



Residue on drain pans



Debug the system

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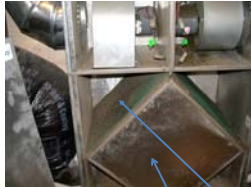
Instructions and Labeling

- “Information on the ventilation design and/or ventilation systems installed, instructions on . . . operation . . . and detailing any required maintenance shall be provided to the owner and the occupant.”
- “Controls shall be labeled as to their function (unless that function is obvious such as toilet exhaust fan switches.”


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Maintenance



Filters need to be cleaned



Core needs to be cleaned

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Maintenance & Commissioning

- System is not completed until it has been tested and commissioned by the installer before leaving the house;
- Homeowner needs to know what the system does, how it does it, and why it is important;
- Homeowner needs to know how to maintain the system.

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Maintenance



Bath vents must go to the outside



Intakes should be cleaned



Exterior hoods maintained

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ASHRAE 62.2 Resources


www.ASHRAE.org **62.2 User's Manual** – available through Resources & Publications *Detailed step-by-step user guide through the Standard* \$54.00

ASHRAE Guideline 24-2008
Beyond the Standard – details on IAQ, commissioning, and documenting
\$54.00

Residential Ventilation Handbook,
Paul H. Raymer, McGraw-Hill, 2010 \$52.45
62.2 System Checklist, Infiltration Credit & Existing Homes Credit
spreadsheet, System Documentation Sheet www.HeyokaSolutions.com



Residential Energy Dynamics
<http://www.residentialenergydynamics.com/Home.aspx>
ResVent App for iPhone and iPad
www.karq.com/resvent622.htm



That's what it's all about!

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