Indoor airPLUS: Ventilation and Filtration Strategies for Zero Energy Ready Homes
The Home of the Future....Today

ZERO
ENERGY READY HOME
U.S. DEPARTMENT OF ENERGY
Website

- [www.buildings.energy.gov/zero/](http://www.buildings.energy.gov/zero/)
- Events:
  - Upcoming in-person ZERH Trainings
  - Technical Training webinars
  - Conference Presentations
- Partner Locator
- Program Specifications
- Webinar Recordings

Building America Solution Center

Thank You

For More Information:
www.buildings.energy.gov/zero

Email:

doechallengehome@newportpartnersllc.com
Indoor airPLUS

Ventilation and Filtration Strategies with Indoor airPLUS and Zero Energy Ready Homes

August 21, 2014
Contents

• Recent changes with Indoor airPLUS

• New in Rev. 2 – Garage ventilation alternatives

• HVAC and IAQ
  – HVAC design requirements
  – Humidity and moisture
  – Filtration

• Additional Resources
ENERGY STAR + Indoor airPLUS

Envelopes + HVAC + Moisture + CO +

Radon + Pests + Materials + CO +
HVAC + Moisture +

Comprehensive Indoor Air Quality Protection

Indoor Air Quality (IAQ)
Reducing Health Risks

1. Source Control
   (eliminate or manage)

2. Ventilation
   (dilution)

3. Filtration
Revision 2

- Released November 2013
- Revised requirements for attached garages
  - Garage fan no longer required for some homes
- New exception from aggregate or sand requirement for slab-on-grade foundations
  - Non-Radon Zone 1 homes only

And now it’s easier to join!
Become an Indoor airPLUS Partner

- For current ENERGY STAR Partners:
  - Log into your My ENERGY STAR Account (MESA) www.energystar.gov/mesa
  - If you don’t know your user name and password, click the link or email energystarhomes@energystar.gov for assistance.
Become an Indoor airPLUS Partner

- After entering your account, click “Join Indoor airPLUS”.
  - For builders, be sure you’ve completed the required ENERGY STAR training.

**To-Do List:**

New Homes Builder Training
You were required to complete training by 06/09/2013. Please complete the training to reactivate your partnership.

Start Training

(Internet Explorer or Firefox are the preferred browsers for this training. Please turn off your browser pop-up blocker.)

**My ENERGY STAR Tools:**

- Linking Opportunities
- Certified Homes Co-brandable Consumer Brochure
- Certified Homes Co-brandable Banners
- Join Indoor airPLUS
How to use the Construction Specifications

• Seven sections:
  – Moisture Control
  – Radon
  – Pests
  – HVAC Systems
  – Combustion Pollutants
  – Materials
  – Home Commissioning

• Broken down into specific measures to address each IAQ concern.
5.4 Attached Garages

1. **Isolated** from conditioned spaces:
   - Common walls and ceilings are **air-sealed**.
   - **No HVAC equipment or ducts** in garage
   - **Weather stripping** and an **automatic door closer** is installed on connecting doors between living space and garage.

2. **Appropriate ventilation strategy** or **pressure testing** ensures separation from living space.
### Revision 2 Combustion Pollutant Changes

<table>
<thead>
<tr>
<th>Section</th>
<th>Changes</th>
</tr>
</thead>
<tbody>
<tr>
<td>5. Combustion Pollutant Control</td>
<td></td>
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</table>
| 5.4 Attached Garages     | **Change:** Homes with a **supply-only or balanced whole-house ventilation system** designed to maintain the living space under a positive or neutral pressure relative to the garage are no longer required to install a garage exhaust fan. Homes with **exhaust-only whole house ventilation** must meet one of the following two requirements:  
  - Equip the attached garage with an exhaust fan with a minimum installed capacity of 70 cfm that is vented directly outdoors.  
  - Verify that the garage-to-house air barrier can maintain a pressure difference of greater than 45 Pascals while the home maintains a 50 Pascal pressure difference with respect to the outdoors. All operable garage openings shall be closed during this test.  
  
  **Advisories Added:** See Revision 2 construction specifications. |

*Indoor Air Quality (IAQ)*

10
5.4 Attached Garages

Verification

- Rater should verify proper functioning of the automatic door closer at final inspection.
- In homes with exhaust only ventilation system, at final inspection Rater should:
  - Visually verify at final inspection that an appropriate garage fan has been installed.
  - If the garage is ventilated by a ducted fan, a Rater should perform a flow test to confirm the required CFM is being met.

OR

- Conduct 45 Pascal pressure test with all garage openings closed to verify the garage-to-house air barrier.
  - Test can be performed during required ENERGY STAR blower door test
  - If garage-to-house air barrier does not pass pressure test, additional air sealing or a garage fan required.

<table>
<thead>
<tr>
<th>Section</th>
<th>Requirements (Refer to full Indoor airPLUS Construction Specifications for details)</th>
<th>Must Correct</th>
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<td>5.2</td>
<td>CO alarms installed in each sleeping zone (e.g., common hallway) according to NFPA 720.</td>
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<td>5.3</td>
<td>Multifamily buildings: Smoking restrictions implemented AND ETS transfer pathways minimized.</td>
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<td>5.4</td>
<td>Attached garages: Door closer installed on all connecting doors AND in homes with exhaust-only whole-house ventilation, EITHER a 70 cfm exhaust fan installed in garage OR a pressure test conducted to verify the effectiveness of the garage-to-house air barrier. See spec for details.</td>
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Indoor Air Quality (IAQ)
Combustion Pollutants

Benefits

- Reduced exposure to carbon monoxide.
- Pollutants in attached garages isolated from living space.
- Round-the-clock peace of mind.
4. HVAC Systems

Effective HVAC

Indoor Air Quality (IAQ)
4. HVAC Systems

• Indoor relative humidity greater than 60% can encourage mold growth and attract organisms such as dust mites or other pests.

• HVAC components in wall cavities and garages can expose occupants to mold, carbon monoxide, hydrocarbons, nitrogen oxides, radon, pesticides and other contaminants.

• Ordinary residential panel filters collect less than 20 percent of the particles between 3 and 10 microns. A MERV 8 filter collects more than 70% of the particles in this range.
4.1 HVAC Sizing and Design

- Properly size all heating and cooling equipment using ACCA Manual J, ASHRAE Handbooks, or equivalent software.

- "Warm-Humid" climates: equipment shall be installed with sufficient latent capacity to maintain indoor relative humidity (RH) at or below 60 percent.
### 4.1 HVAC Sizing and Design

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<th>Elevation (Feet)</th>
<th>Latitude Degrees North</th>
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<th>Cooling 1% Dry Bulb</th>
<th>Coincident Wet Bulb</th>
<th>Design Grains 55% RH</th>
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</table>
4.1 HVAC Sizing and Design

• Heating and cooling equipment generally has just two modes – on & off.
• Right sizing is key in controlling RH with HVAC systems
• The HVAC system must operate to remove moisture!
4.1 HVAC Sizing and Design

• By following the procedures in Manual S for selecting HVAC systems you can ensure the HVAC system selected can cover the Latent (Moisture) load of the home.

• HVAC systems have a broad range of capabilities depending on fan speeds and controls.

• A humidistat may be used in some systems to achieve additional dehumidification.

• In some extreme cases a separate dehumidifier may be required to supplement moisture removal.
4.1 HVAC Sizing and Design

Controlled to $\leq 60\%$ RH

For IECC climate zone map, visit www.iccsafe.org
4.1 HVAC Sizing and Design

- Total Design Capacity = 33.2 kBTU/h
- Sensible Design Capacity = 33.2 x 0.83 = 27.6 kBTU/h
- Latent Design Capacity = 33.2 - 27.6 = 5.6 kBTU/h
4.1 HVAC Sizing and Design Verification

- Must be Rater verified.
- Rater should **verify documentation before the start of construction** showing the method and calculations for retaining an indoor relative humidity below 60 percent.
- Rater should **visually verify at final inspection** that the designed system has been properly installed.

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<td>4.1</td>
<td>Equipment selected to keep relative humidity &lt; 60% in “Warm-Humid” climates (Exception: see spec).</td>
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<td>4.2</td>
<td>Duct systems protected from construction debris AND no building cavities used as air supplies or returns.</td>
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<tr>
<td>4.3</td>
<td>No air-handling equipment or ductwork installed in garage AND continuous air barrier in adjacent assemblies.</td>
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<tr>
<td>4.7</td>
<td>Central forced-air HVAC system(s) have minimum MERV 8 filter AND no ozone generators in home.</td>
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</table>
4.2 Duct System Design and Installation

• Design all duct systems according to ACCA Manual D, ASHRAE Handbooks, or equivalent software.

• Ensure that all duct systems are airtight and properly balanced.

• Do not use building cavities as part of the forced air supply or return systems.

• Cover duct openings throughout construction or vacuum out ducts prior to installing registers.
4.2 Duct System Design and Installation

COVERING DUCT OPENINGS DURING CONSTRUCTION

SEALING WITH MASTIC
BUILDING CAVITIES (E.G., PANNELED JOISTS) SHALL NOT BE USED AS FORCED-AIR SUPPLIES OR RETURNS (1 OF 2)
Building cavities (e.g., panned joists) shall not be used as forced air supplied or returns, 2/2.
4.2 Duct System Design and Installation Verification

- Can be builder or Rater verified.
- **Visually verify at pre-drywall inspection** that no cavities are used as part of the forced air system.
- Verify that all duct openings were covered during construction or have been thoroughly vacuumed upon completion.

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</table>
4.3 Location of Air Handler and Ducts

- Do not locate air-handling equipment or ductwork in garages.
- Note: Ducts may be located in building cavities adjacent to the garage if they are separated with a continuous air barrier.
4.3 Location of Air-Handling Equipment and Ductwork

Verification

- Must be Rater verified.
- Rater should **visually verify at pre-drywall inspection** that no air-handling equipment of ductwork has been installed in the garage and any ducts or equipment located in adjacent framing spaces has been separated from the garage space by a continuous air barrier.

<table>
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Indoor Air Quality (IAQ)
4.5 Mechanical Whole-House Ventilation

• Provide mechanical whole-house ventilation meeting ASHRAE 62.2-2010.

• Test airflows to ensure they meet ASHRAE 62.2-2010.

• Advisory: Outdoor air ducts connected to the return side of an air handler should be used as supply ventilation only if the manufacturers’ requirements for return air temperature are met.
4.5 Mechanical Whole-House Ventilation

- Fresh Air Damper
- Ducted Fresh Air Supply

Indoor Air Quality (IAQ)
4.7 Filtration

- Equip all filter access panels with gasket material or comparable sealing mechanism to prevent bypass air.

- Install only HVAC filters that are rated MERV 8 or higher.
- Do not install any air-cleaning equipment designed to produce ozone.
• 4.7 Filtration for Central Forced-Air HVAC Systems

- Filters come multiple sizes.
- Filters are typically 1”, 2”, or 4” in depth.
- In years past the primary purpose for filtration was to protect the HVAC system not IAQ.
• 4.7 Filtration for Central Forced-Air HVAC Systems

- Filters have performance data that must be accounted for in the duct design.
- When selecting a filter try to find a filter that creates the least amount of resistance.
- There are multiple types of filter sizes and depths.
- Media filters have a much greater surface area and will cause less restriction.

<table>
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<tr>
<th>Filter Depth</th>
<th>Nominal Size</th>
<th>Capacities (CFM)</th>
<th>Resistance (inches W.G.)</th>
<th>Pleats per Linear foot</th>
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<td>2500</td>
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<td>11 29.3</td>
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</table>
4.7 Filtration for Central Forced-Air HVAC Systems

Verification

• Can be builder or Rater verified.
• Coordinate with the builder and/or HVAC contractor before the start of construction to ensure that:
  • no ozone-producing air-cleaning equipment will be installed AND
  • a MERV 8 filter is accommodated in the HVAC design.
• Visually verify at final inspection that the filter has been installed.

<table>
<thead>
<tr>
<th>Section</th>
<th>Requirements (Refer to full Indoor airPLUS Construction Specifications for details)</th>
<th>Must Correct</th>
<th>Builder Verified</th>
<th>Rater Verified</th>
<th>N/A</th>
</tr>
</thead>
<tbody>
<tr>
<td>4.1</td>
<td>Equipment selected to keep relative humidity &lt; 60% in “Warm-Humid” climates (Exception: see spec).</td>
<td>☐</td>
<td>☐</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4.2</td>
<td>Duct systems protected from construction debris AND no building cavities used as air supplies or returns.</td>
<td>☐</td>
<td>☐</td>
<td></td>
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</tr>
<tr>
<td>4.3</td>
<td>No air-handling equipment or ductwork installed in garage AND continuous air barrier in adjacent assemblies.</td>
<td>☐</td>
<td>☐</td>
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<tr>
<td>4.7</td>
<td>Central forced-air HVAC system(s) have minimum MERV 8 filter AND no ozone generators in home.</td>
<td>☐</td>
<td>☐</td>
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</tbody>
</table>
4. HVAC Systems

Homeowner Benefits

- Reduced exposure to mold and mildew
- Increased comfort
- Helps remove allergens, toxins, irritants and asthma triggers from the home
- House stays cleaner
Resources and Tools
Marketing and Technical Support for Partners

- Construction requirements
- Technical guidance
- Recorded webinars
- YouTube videos
- Builder and consumer resources
- Partner locator
- Website widgets
- Free brochures

www.epa.gov/indoorairplus
New Marketing Resources

Co-brandable Consumer Brochure
• Add company name, logo, and other info (testimonials, etc.)

Visit your My ENERGY STAR Account
www.energystar.gov/MESA
Indoor airPLUS construction specifications are designed to help improve indoor air quality (IAQ) in new homes compared with homes built to minimum code. However, these features alone cannot prevent all IAQ problems. Occupant behavior is also important for IAQ. For example, products used in the home after occupancy and smoking inside may both negatively impact the home’s IAQ and the performance of the specified indoor airPLUS features.

See: http://www.epa.gov/indooraaplus/ for more information.
Indoor airPLUS Leader Awards

2014 Leader Award Winners

Raters:
- ASERusa
- E3 Energy
- Integral Building & Design, Inc.
- Steven Winter Associates, Inc.

Builders:
- Foxwood Builders, Inc.
- Palo Duro Homes, Inc.
- C&B Construction

Also watch for DOE's Housing Innovation Awards (for ZERH partners)
- To be announced at the 2014 EEBA Excellence in Building Conference, St. Louis, MO – Sept. 23, 2014

http://www.epa.gov/indoorairplus/leader_awards
Resources and Tools

https://basc.pnnl.gov/

Building America Solution Center

The Building America Solution Center provides access to expert information on hundreds of high-performance construction topics, including air sealing and insulation, HVAC components, windows, indoor air quality, and much more. Click on the links below to explore the Solution Center.

More IAQ resources coming soon! Please consider submitting images and content:

https://basc.pnnl.gov/criteria-submitting-content-building-america-solution-center

Indoor Air Quality (IAQ)
Indoor airPLUS
A new opportunity for leading builders to create better environments inside and out

Learn more at:
www.epa.gov/indoorairplus

OR contact the Indoor airPLUS Team at
indoor_airPLUS@epa.gov