United States Environmental Protection Agency

Building and Verifying Indoor airPLUS Homes

Energy and Environmental Building Alliance, September 24, 2013

look for EPA Indoor airPLUS QUALIFIED HOMES

Indoor Air Quality (IAQ)

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- **Indoor airPLUS Basics**
- **Importance of High QUALITY Indoor Air**
- **How to Build and Verify Indoor airPLUS Homes**
- **Question and Answer**

Indoor airPLUS Basics

ENERGY STAR + Indoor airPLUS

Indoor airPLUS is an EPA label that adds health protections to your **ENERGY STAR** value proposition

ENERGY STAR + Indoor airPLUS

ENERGY STAR

- Envelope
- HVAC
- Moisture
- CO

+

look for EPA Indoor airPLUS QUALIFIED HOME

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

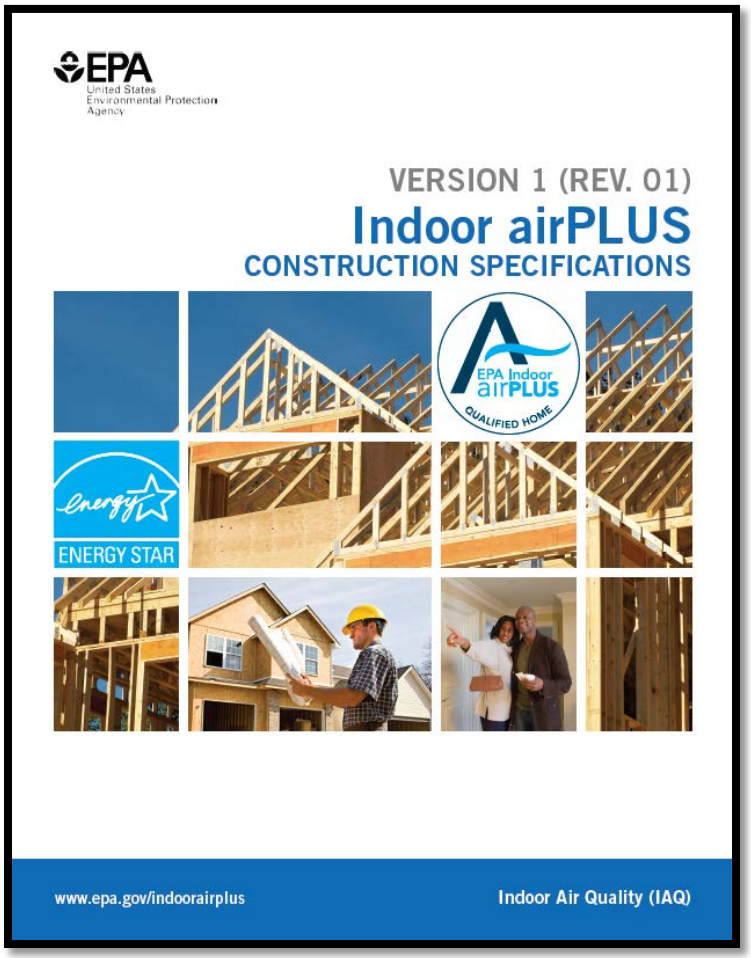
=

Complete Indoor Air Quality Protection

ENERGY STAR + Indoor airPLUS

- Both programs are based on building science principles that use a systems approach to improve home performance issues.
- Both programs require completion of verification checklists by a certified Home Energy Rater.
- Visual inspection items can be verified during the same on-site visits by a certified Home Energy Rater.
- Reporting to the EPA follows the same schedule and is completed using the same online program.

Revision 1



- **Released February 2013.**
- **Greater alignment with ENERGY STAR Version 3.**
- **Simplified, clearer specifications.**
- **More flexibility and climate specific exemptions.**

How to use the Construction Specifications

- **Seven sections:**
  - Moisture Control
  - Radon
  - Pests
  - HVAC Systems
  - Combustion Pollutants
  - Materials
  - Final

- **Broken down into specific measures to address each IAQ concern.**

1. Moisture Control

1.1 Site and Foundation Drainage

NOTE: Completion of the ENERGY STAR checklists now satisfies the following Indoor airPLUS requirements:

- *Slope patio slabs, walks and driveway; tamp back-fill to prevent settling; AND slope the final grade away from the foundation (WMS 1.1 and 1.2).*
- *Swales or drains designed to carry water away from the foundation are permitted to be provided as an alternative to the slope requirements for any home, and shall be provided for a home where setbacks limit space to less than 10 ft. (WMS 1.1and 1.2).*
- *Install protected drain tile at the footings of basement and crawlspace walls. Surround each drain tile pipe with washed or clean gravel wrapped with fabric cloth, or install an approved Composite Foundation Drainage System (CFDS) (WMS 1.8).*

Additional Indoor airPLUS Requirements:

- Install a drain or sump pump in basement and crawlspace floors, discharging to daylight at least 10 ft. outside the foundation or into an approved sewer system.
- **Exceptions:**
  - Slab-on-grade foundations.
  - In areas of free-draining soils — identified as Group 1 (Table R405.1, 2009 IRC) by a certified hydrologist, soil scientist, or engineer through a site visit — installation of a drain or sump pump is not required.
- In EPA Radon Zone 1, if a drain tile discharges to daylight install a check valve at the drain tile outfall (see Specification 2.1).

How to use the Construction Specifications

- **Relevant ENERGY STAR checklist items are summarized and referenced at the beginning of each measure.**

- **Additional Indoor airPLUS requirements are listed separately. These include:**
  - Items that provide additional indoor air quality protections.
  - Requirements that exclude an ENERGY STAR exception.

1. Moisture Control

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How to use the Construction Specifications

- **ENERGY STAR checklists are referenced as follows:**

- **TES** =Thermal Enclosure System Rater Checklist
- **HVAC-C** = HVAC System Quality Installation Contractor Checklist
- **HVAC-R** = HVAC System Quality Installation Rater Checklist
- **WMS** = Water Management System Builder Checklist

1. Moisture Control

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- In EPA Radon Zone 1, if a drain tile discharges to daylight install a check valve at the drain tile outfall (see Specification 2.1).

How to Complete the Verification Checklist

- All ENERGY STAR Certified Homes checklists must be successfully completed and reported to achieve Indoor airPLUS certification.
- Check one box per line.
- Check “N/A” for specifications that do not apply for specific conditions (e.g., climate) according to the exceptions described.
- Check either “Builder Verified” or “Rater Verified” for all other items.

Home Address:		City:	State:	Zip:	
Section	**Requirements (Refer to full Indoor airPLUS Construction Specifications for details)**	**Must Correct**	**Builder Verified**	**Rater Verified**	**N/A**
	Note: **The Rev. 02 checklist has been modified to reflect only the additional Indoor airPLUS requirements and their corresponding section numbers that must be met after completing the ENERGY STAR checklists. ENERGY STAR remains a prerequisite for Indoor airPLUS certification.**				
ENERGY STAR V3 Checklists	Thermal Enclosure System Rater Checklist completed.	☐		☐	
	Water Management System Builder Checklist completed.	☐		☐	
	HVAC System Quality Installation Contractor Checklist completed.	☐		☐	
	HVAC System Quality Installation Rater Checklist completed.	☐		☐	

How to Complete the Verification Checklist

- **Items may be verified:**
  - visually on site during construction.
  - by reviewing photographs taken during construction.
  - by checking documentation.

Home Address:		City:	State:	Zip:	
Section	**Requirements (Refer to full Indoor airPLUS Construction Specifications for details)**	**Must Correct**	**Builder Verified**	**Rater Verified**	**N/A**
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ENERGY STAR V3 Checklists	Thermal Enclosure System Rater Checklist completed.	☐		☐	
	Water Management System Builder Checklist completed.	☐		☐	
	HVAC System Quality Installation Contractor Checklist completed.	☐		☐	
	HVAC System Quality Installation Rater Checklist completed.	☐		☐	

How to Complete the Verification Checklist

- Raters who operate under a Sampling Provider are permitted to use a RESNET-approved sampling protocol for Indoor airPLUS verification (for items “Rater Verified” on-site or through documentation).
- All items verified by the builder shall be verified for <u>each</u> qualified home.
- The builder provides one copy of the completed and signed Indoor airPLUS Verification Checklist for the buyer.
- The HERS Provider or Rater files a copy of the HERS and ENERGY STAR documentation for the home.

What About Multifamily Dwellings?

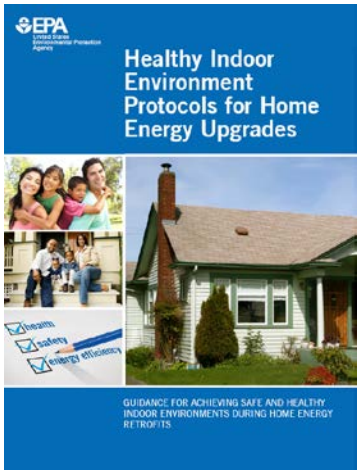
- Multifamily dwellings that meet the ENERGY STAR Certified Homes, Version 3 National Program Requirements can pursue Indoor airPLUS.
  - Buildings that would only be eligible for the ENERGY STAR Multifamily High Rise Program are not eligible for Indoor airPLUS at this time.

- Multi-family requirements are the same as single-family, PLUS:
  - Compartmentalization
  - Non-smoking policies

What About Existing Homes?

- Indoor airPLUS not designed for existing homes
- Under certain conditions, (e.g., gut rehabs) if ENERGY STAR requirements and Indoor airPLUS requirements met.
- For most renovation and energy upgrade work, see EPA's Healthy Indoor Environment Protocols for Home Energy Upgrades.

http://www.epa.gov/iaq/homes/retrofits.html



What does Indoor airPLUS cost?

- No fee to participate in the EPA program.
- Raters may charge a verification fee.
- Cost of Indoor airPLUS features will vary based on:
  - Local code requirements and typical building practices.
  - Climate Zone (e.g., moist versus dry)
  - Radon Zone
  - Features (e.g., attached garage)
  - Availability of suppliers and cost of materials
  - Type of construction (e.g., below grade foundation or slab on grade)
- Cost of additional features could be a few hundred dollars in dry, non-Radon Zone 1 areas or up to a few thousand dollars in moist climates in Radon Zone 1.

High Quality Indoor Air

Radon

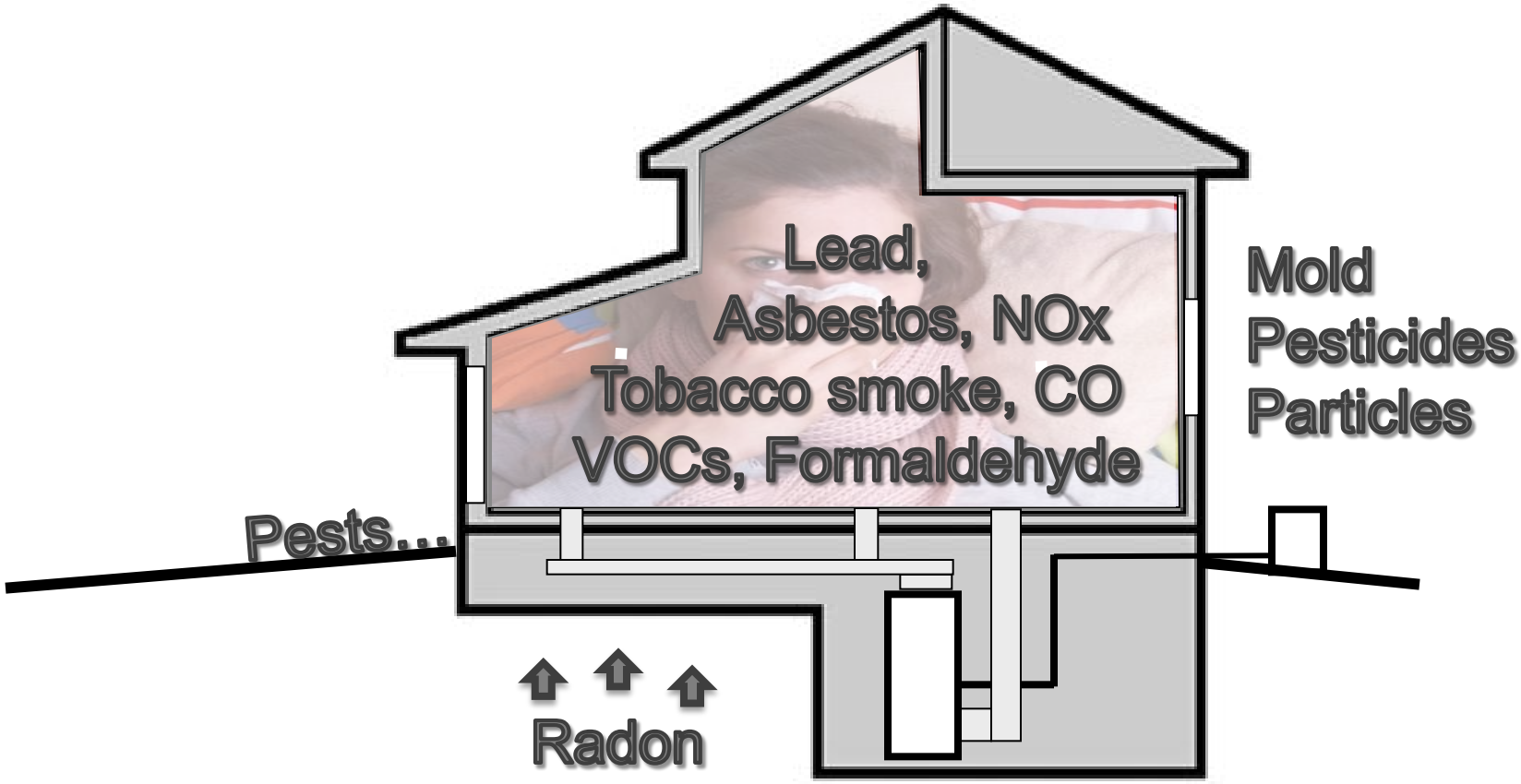
What Causes Low Quality Indoor Air?

- **Pollution sources that release gases or particles into the air are the primary cause.**
- **Inadequate ventilation can increase indoor pollutant levels.**

Health Risks

May appear after a single exposure, years after exposure, or only after long or repeated periods of exposure.

Health Risks



Health Plan

Source Control

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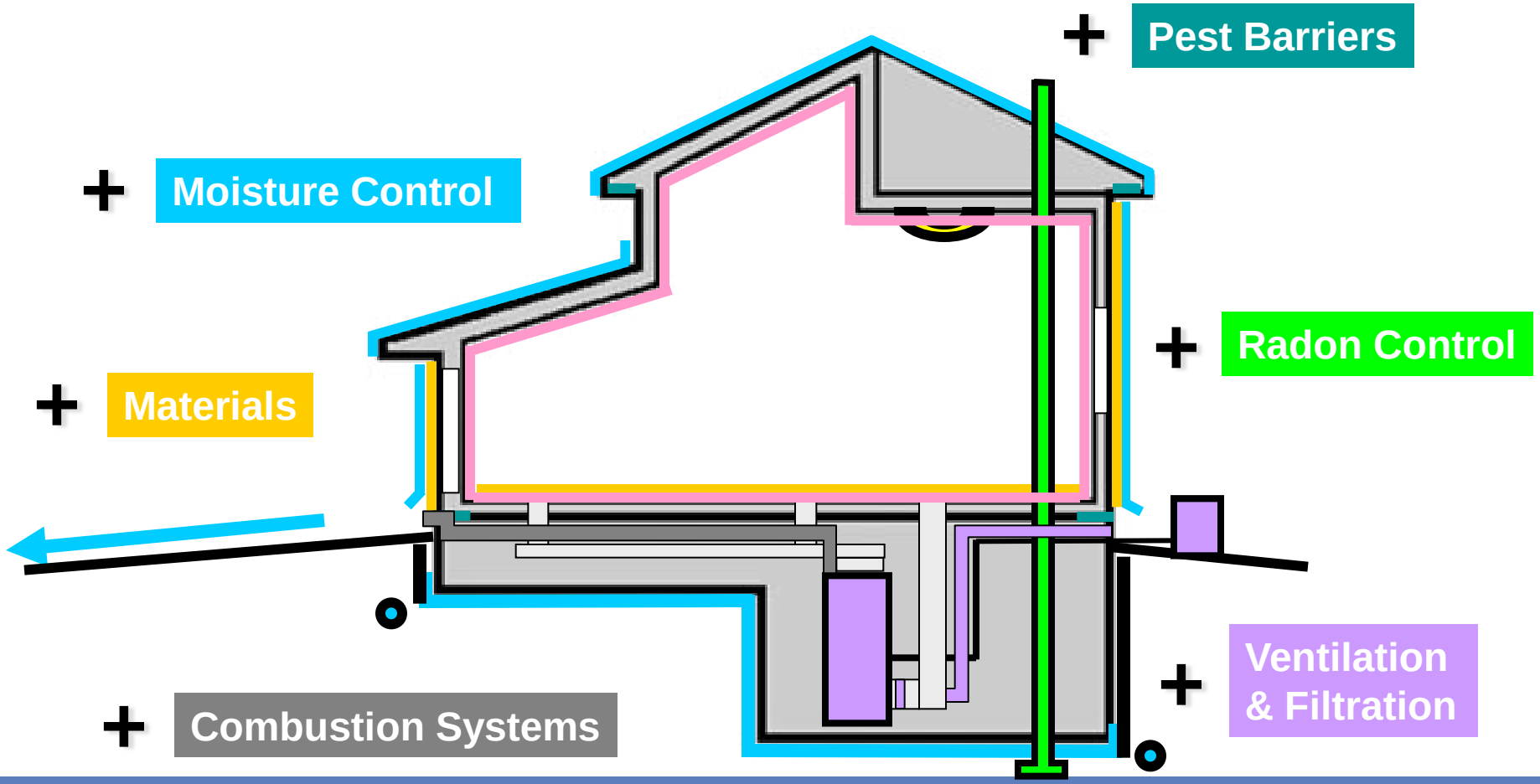
Ventilation

↓

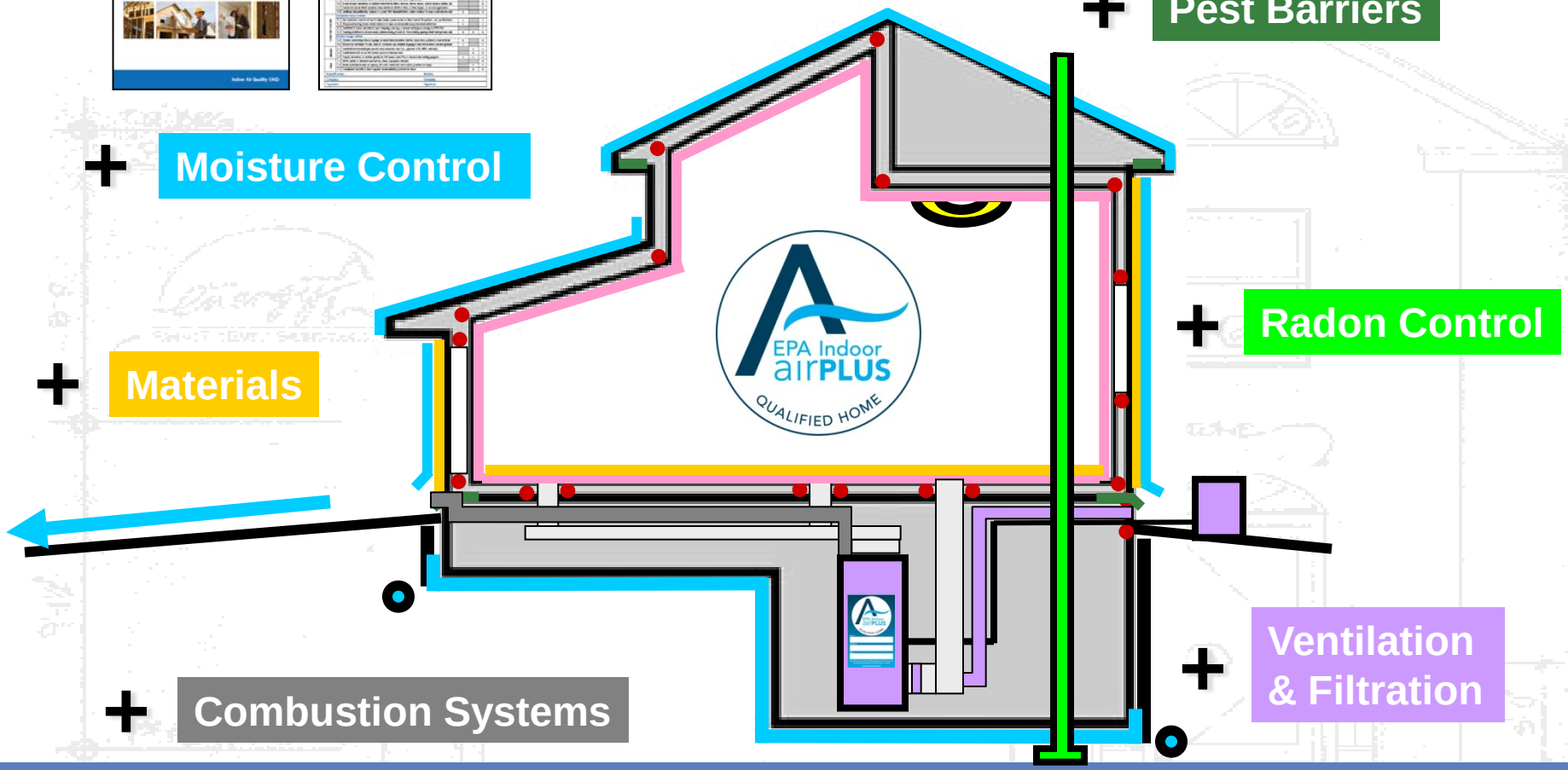
Air Cleaning

Health Plan



Indoor Air Quality (IAQ)

Indoor airPLUS



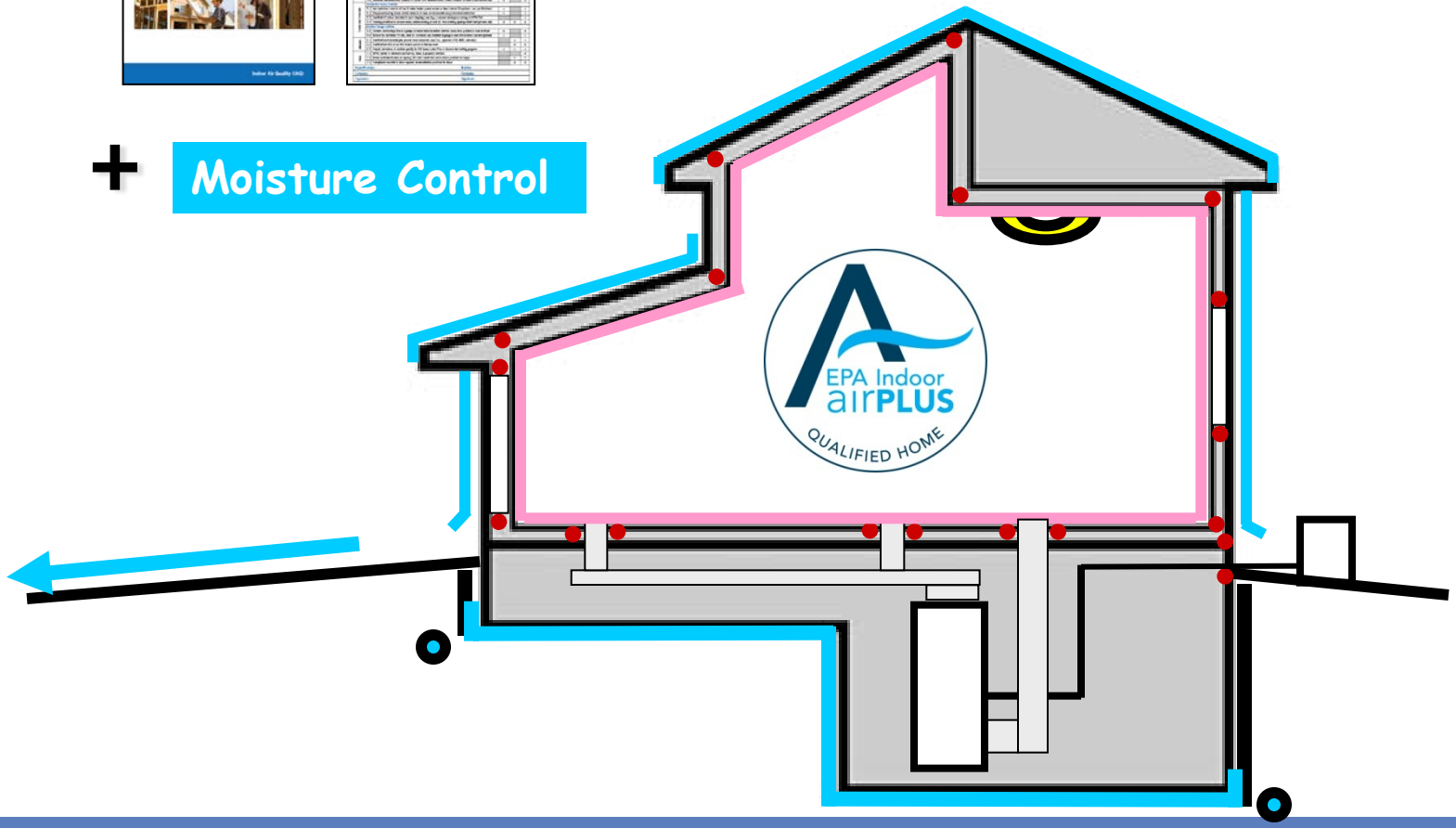
Indoor Air Quality (IAQ)

How to Build and Verify Indoor airPLUS Homes

Indoor Air Quality (IAQ)

1. Moisture Control

+ Moisture Control



look for EPA Indoor airPLUS QUALIFIED HOME

Indoor Air Quality (IAQ)

1. Moisture Control

- Moisture is a leading cause of health, comfort and durability concerns in homes.
- 19% of U.S. Households have at least one person with Asthma.
- There is a 20-50% increased risk of asthma in damp houses.
- The annual economic cost of asthma amounts to more than $56 billion annually.
- Mold grows where there is moisture.
- Molds produce allergens, irritants, and in some cases, potentially toxic substances.

1.1 Site and Foundation Drainage

- *Slope hard surfaces and final grade away from the foundation.*
- *Install drain tile at the footings of basement and crawlspace walls.*

- **Install a drain or sump in basement and crawlspace floors.**

1.1 Site and Foundation Drainage

Verification

- Can be builder or rater verified.
- **Visually verify during pre-slab** inspection the drain or sump pump's discharge to daylight (including distance from the foundation) or connection to the sewer.
- In Radon Zone 1, visually verify check-valve installed.
- Review documentation of free-draining soils when the exception is used.

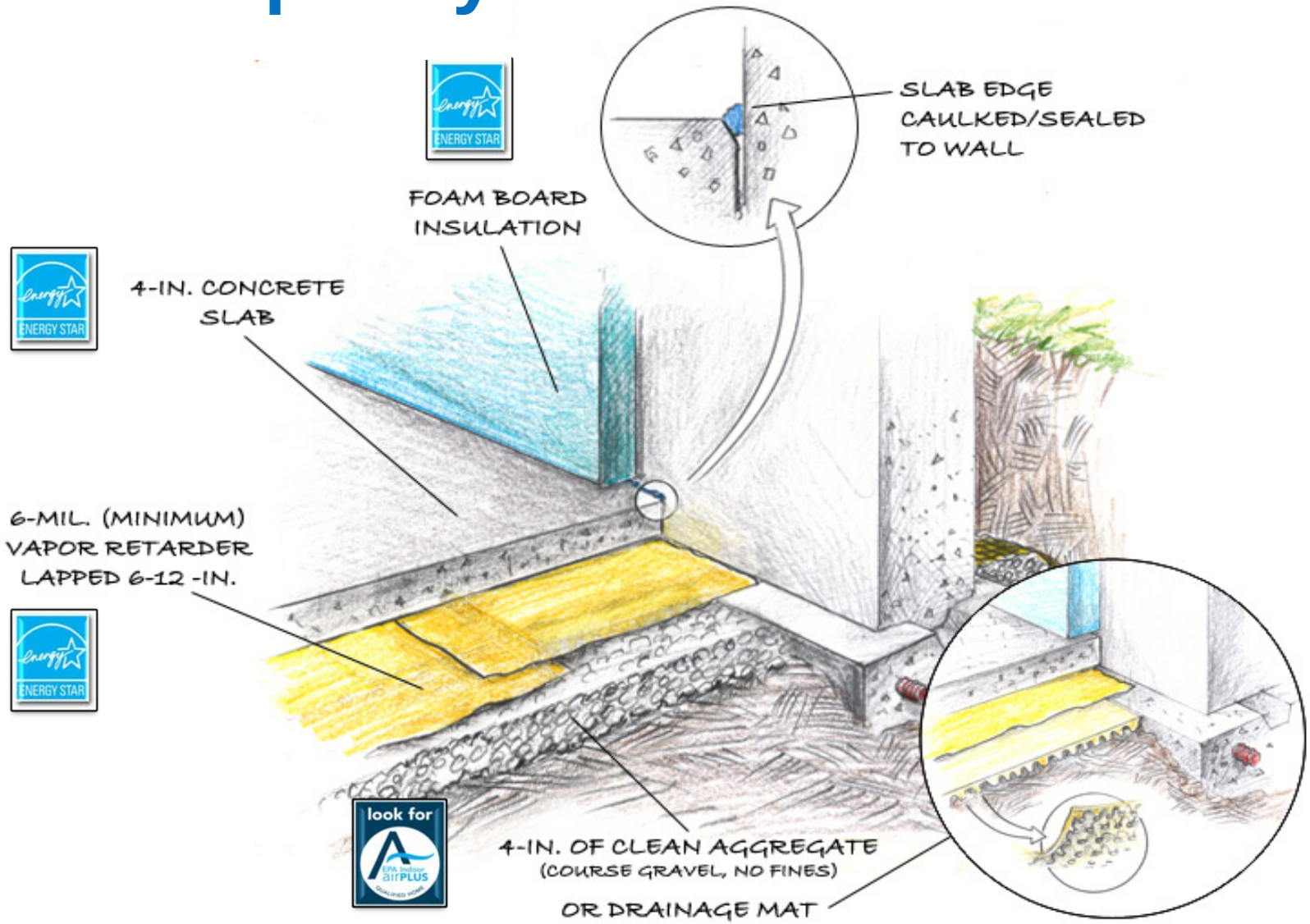
Section		Requirements (Refer to full Indoor airPLUS Construction Specifications for details)	Must Correct	Builder Verified	Rater Verified	N/A
Moisture Control	1.1	Drain or sump pump installed in basements and crawlspaces (Exception: free-draining soils). In EPA Radon Zone 1, check valve also installed.	☐	■	☐	☐
	1.2	Layer of aggregate or sand (4 in.) with geotextile matting installed below slabs (Exceptions: see spec) AND radon techniques used in EPA Radon Zone 1.	☐	☐	☐	☐
	1.4	Basements/crawlspaces insulated, sealed and conditioned (Exceptions: see spec).	☐	☐	☐	☐
	1.7	Protection from water splash damage if no gutters (Exceptions: see spec).	☐		☐	☐
	1.11	Hard-surface flooring in kitchens, baths, entry, laundry and utility rooms, AND piping in exterior walls insulated with pipe wrap.	☐		☐	

1.2 Capillary Break Installation

- *Install polyethylene sheeting or extruded polystyrene beneath concrete slabs.*
- *Install a capillary break at all crawlspace floors using polyethylene sheeting.*

- **Under the polyethylene sheeting or extruded polystyrene (XPS) insulation:**
  - **Install a 4 in. layer of aggregate; OR**
  - **A uniform layer of sand, overlain with a layer of geotextile drainage matting.**

1.2 Capillary Break Installation



BASEMENT SLAB W/ CAPILLARY BREAK - GRAVEL AND GEOTEXTILE MAT (INSET)

1.2 Capillary Break Installation

Verification

- Can be builder or rater verified.
- **Visually verify during pre-slab inspection** the capillary break is properly installed.
- In Radon Zone 1: Visually verify polyethylene sheeting has been overlapped 6 – 12 in. and the ENERGY STAR staking method for crawlspaces has not been used.

Section		Requirements (Refer to full Indoor airPLUS Construction Specifications for details)	Must Correct	Builder Verified	Rater Verified	N/A
Moisture Control	1.1	Drain or sump pump installed in basements and crawlspaces (Exception: free-draining soils). In EPA Radon Zone 1, check valve also installed.	☐	■	☐	☐
	1.2	Layer of aggregate or sand (4 in.) with geotextile matting installed below slabs (Exceptions: see spec) AND radon techniques used in EPA Radon Zone 1.	☐	■	☐	☐
	1.4	Basements/crawlspaces insulated, sealed and conditioned (Exceptions: see spec).	☐	☐	☐	☐
	1.7	Protection from water splash damage if no gutters (Exceptions: see spec).	☐		☐	☐
	1.11	Hard-surface flooring in kitchens, baths, entry, laundry and utility rooms, AND piping in exterior walls insulated with pipe wrap.	☐		☐	

1.3+1.4 Below-grade Foundation Walls

- *Waterproof crawlspace and basement perimeter walls.*
- *All floors above unconditioned spaces shall be insulated.*

- **Insulate crawlspace and basement perimeter walls.**
- **Seal crawlspace and basement perimeter walls.**
- **Provide conditioned air.**

1.4 Basement and Crawlspace

Verification

- Can be builder or rater verified.
- **Visually verify during pre-drywall** inspection the proper sealing and insulation (IECC 2009) of the crawlspace/basement.
- Review **documented calculations before the start of construction** for the required condition air rate.

Section		Requirements (Refer to full Indoor airPLUS Construction Specifications for details)	Must Correct	Builder Verified	Rater Verified	N/A
Moisture Control	1.1	Drain or sump pump installed in basements and crawlspaces (Exception: free-draining soils). In EPA Radon Zone 1, check valve also installed.	☐	■	☐	☐
	1.2	Layer of aggregate or sand (4 in.) with geotextile matting installed below slabs (Exceptions: see spec) AND radon techniques used in EPA Radon Zone 1.	☐	■	☐	☐
	1.4	Basements/crawlspaces insulated, sealed and conditioned (Exceptions: see spec).	☐	☐	■	☐
	1.7	Protection from water splash damage if no gutters (Exceptions: see spec).	☐		☐	☐
	1.11	Hard-surface flooring in kitchens, baths, entry, laundry and utility rooms, AND piping in exterior walls insulated with pipe wrap.	☐		☐	

1.4 Basement and Crawlspace

Verification

TABLE 402.1.1
INSULATION AND FENESTRATION REQUIREMENTS BY COMPONENT[a]

CLIMATE ZONE	FENESTRATION *U*-FACTOR[b]	SKYLIGHT[b] *U*-FACTOR	GLAZED FENESTRATION SHGC[b, e]	CEILING *R*-VALUE	WOOD FRAME WALL *R*-VALUE	MASS WALL *R*-VALUE[i]	FLOOR *R*-VALUE	BASEMENT[c] WALL *R*-VALUE	SLAB[d] *R*-VALUE & DEPTH	CRAWL SPACE[c] WALL *R*-VALUE
1	1.2	0.75	0.30	30	13	3/4	13	0	0	0
2	0.65[j]	0.75	0.30	30	13	4/6	13	0	0	0
3	0.50[j]	0.65	0.30	30	13	5/8	19	5/13[f]	0	5/13
4 except Marine	0.35	0.60	NR	38	13	5/10	19	10 /13	10, 2 ft	10/13
5 and Marine 4	0.35	0.60	NR	38	20 or 13+5[h]	13/17	30[g]	10/13	10, 2 ft	10/13
6	0.35	0.60	NR	49	20 or 13+5[h]	15/19	30[g]	15/19	10, 4 ft	10/13
7 and 8	0.35	0.60	NR	49	21	19/21	38[g]	15/19	10, 4 ft	10/13

1.5 – 1.7 Wall Drainage System

- *Install a drainage plane behind exterior wall cladding.*
- *Install flashing at the bottom of exterior walls.*
- *Fully flash all window and door openings.*
- *Direct roof water away from the house using gutters or an underground catchment system.*

- **For homes that meet ENERGY STAR exceptions for gutters and downspouts, provide protection for water splash damage by one of the following**
  - **Extend the foundation walls 16 in. above grade.**
  - **Provide a drip line that is 16 in. from the foundation.**
  - **Install a drainage plane that extends at least 16 in. above grade.**

1.7 Gutters, Downspouts, and Site Drainage

Verification

- Must be rater verified.
- The Rater should **verify documentation before the start of construction** what ENERGY STAR or Indoor airPLUS compliance option is being pursued.
- The Rater should **visual verify at final inspection** that the selected compliance option is properly installed (for example that the foundation wall is extended *at least 16in.* above final grade).

Section		Requirements (Refer to full Indoor airPLUS Construction Specifications for details)	Must Correct	Builder Verified	Rater Verified	N/A
Moisture Control	1.1	Drain or sump pump installed in basements and crawlspaces (Exception: free-draining soils). In EPA Radon Zone 1, check valve also installed.	☐	■	☐	☐
	1.2	Layer of aggregate or sand (4 in.) with geotextile matting installed below slabs (Exceptions: see spec) AND radon techniques used in EPA Radon Zone 1.	☐	■	☐	☐
	1.4	Basements/crawlspaces insulated, sealed and conditioned (Exceptions: see spec).	☐	☐	■	☐
	1.7	Protection from water splash damage if no gutters (Exceptions: see spec).	☐		■	☐
	1.11	Hard-surface flooring in kitchens, baths, entry, laundry and utility rooms, AND piping in exterior walls insulated with pipe wrap.	☐		☐	

1.11 Moisture-Resistant Materials

- *Install moisture-resistant backing material behind tub and shower enclosures.*
- *Install a corrosion-resistant drain pan.*

- **Install only water-resistant hard-surface flooring in kitchens, bathrooms, entryways, laundry areas, and utility rooms.**
- **Insulate water supply pipes in exterior walls with pipe wrap.**

1.11 Moisture Resistant-Materials

Verification

- Must be rater verified.
- The Rater should **visually verify at the pre-drywall inspection** that all water supply lines in exterior walls are properly insulated with pipe wrap.
- The Rater should **visually verify at final inspection** that only water-resistant hard-surface flooring is installed in the required rooms.

Section		Requirements (Refer to full Indoor airPLUS Construction Specifications for details)	Must Correct	Builder Verified	Rater Verified	N/A
Moisture Control	1.1	Drain or sump pump installed in basements and crawlspaces (Exception: free-draining soils). In EPA Radon Zone 1, check valve also installed.	☐	■	☐	☐
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1. Moisture Control / Water Management

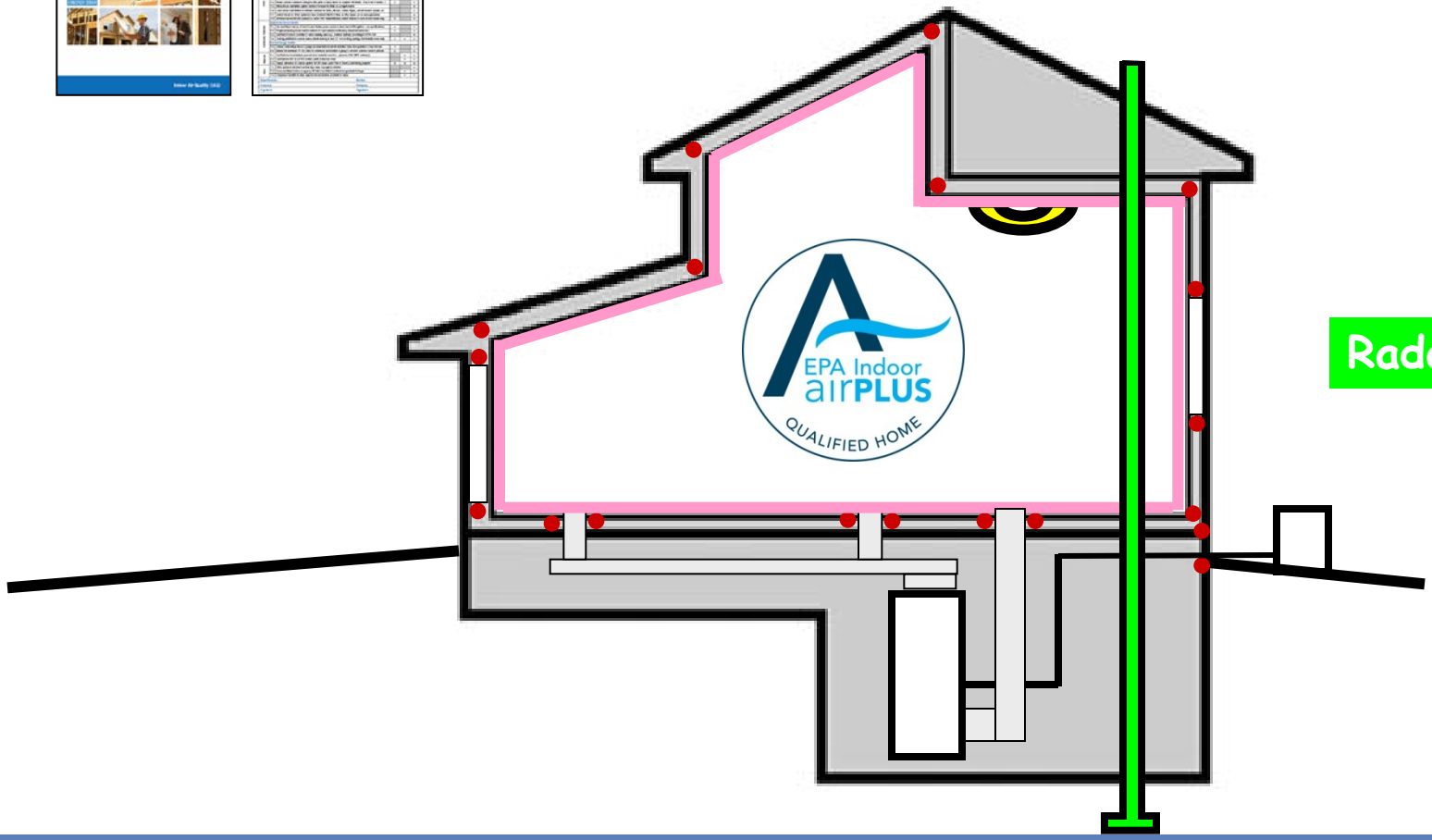
Benefits

- Structural durability.
- Flood mitigation.
- Fewer maintenance issues from peeling paint and moldy grout.
- Moisture and water damage reduction.
- Prevents mold growth – even in places you can't see.

2. Radon

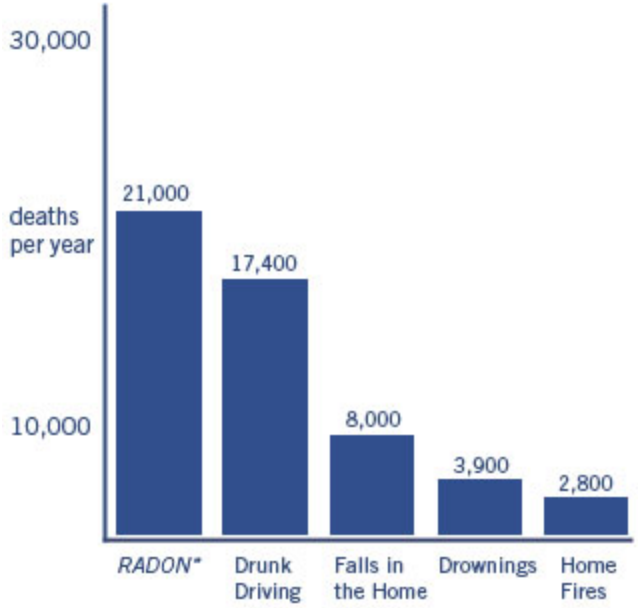
SURGEON GENERAL'S WARNING:

Radon Causes Lung Cancer. You Should Test Your Home.



Radon Control

2. Radon



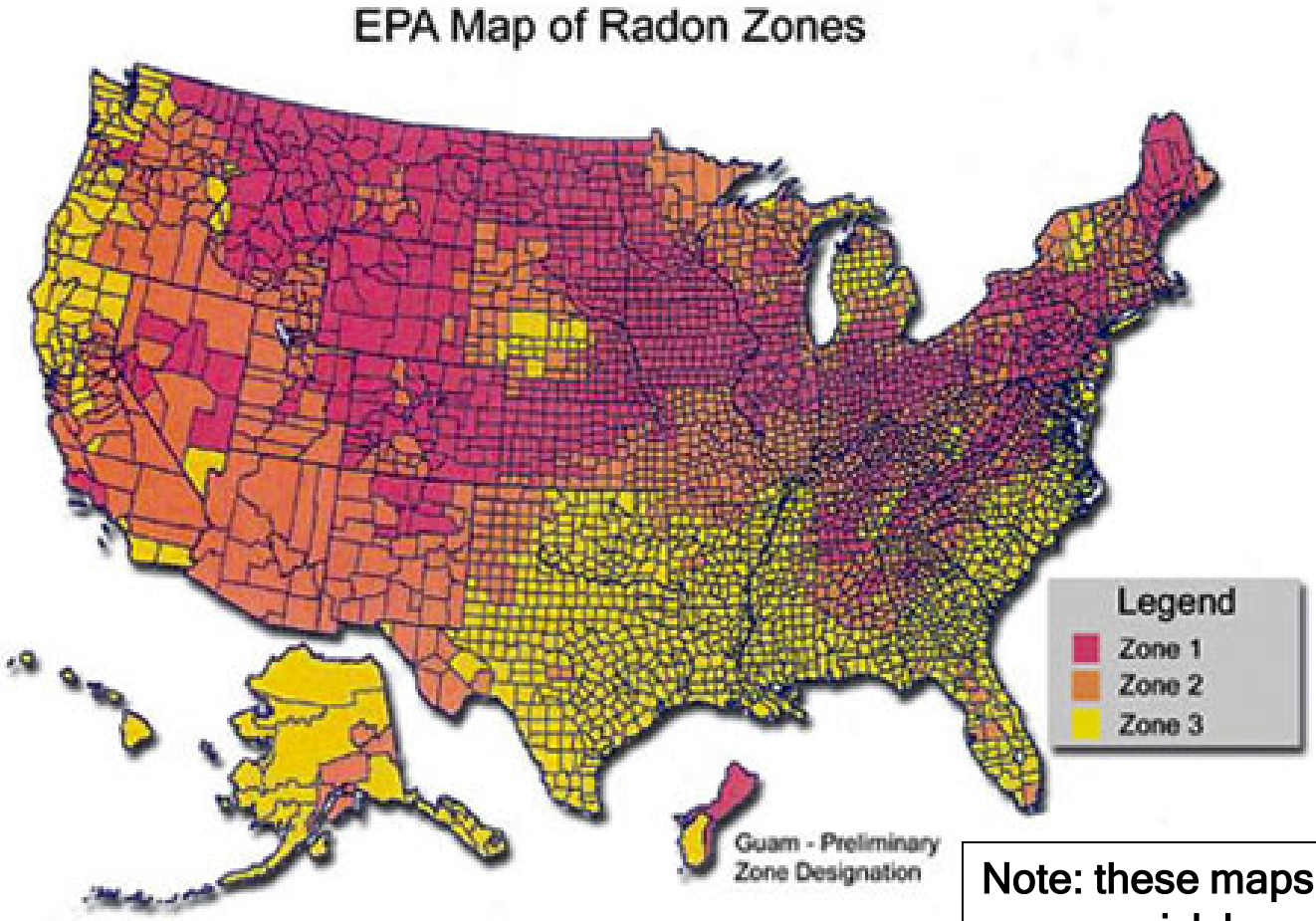
- Radon is a cancer-causing, radioactive gas created by the natural breakdown of uranium in soil.
- Radon can be found all over the US.
- 1 in 15 homes have Radon above 4 pCi/L.
- You are most likely to get your greatest exposure to Radon at home.
- Radon is the second leading cause of lung cancer after smoking.

2.1 Radon Control

- *Air seal all sump covers.*

- **Construct homes built in EPA Radon Zone 1 with radon-resistant features.**
- **Advisory:**
  - **Passive Systems in Zones 2 & 3.**
  - **Educate homeowners.**

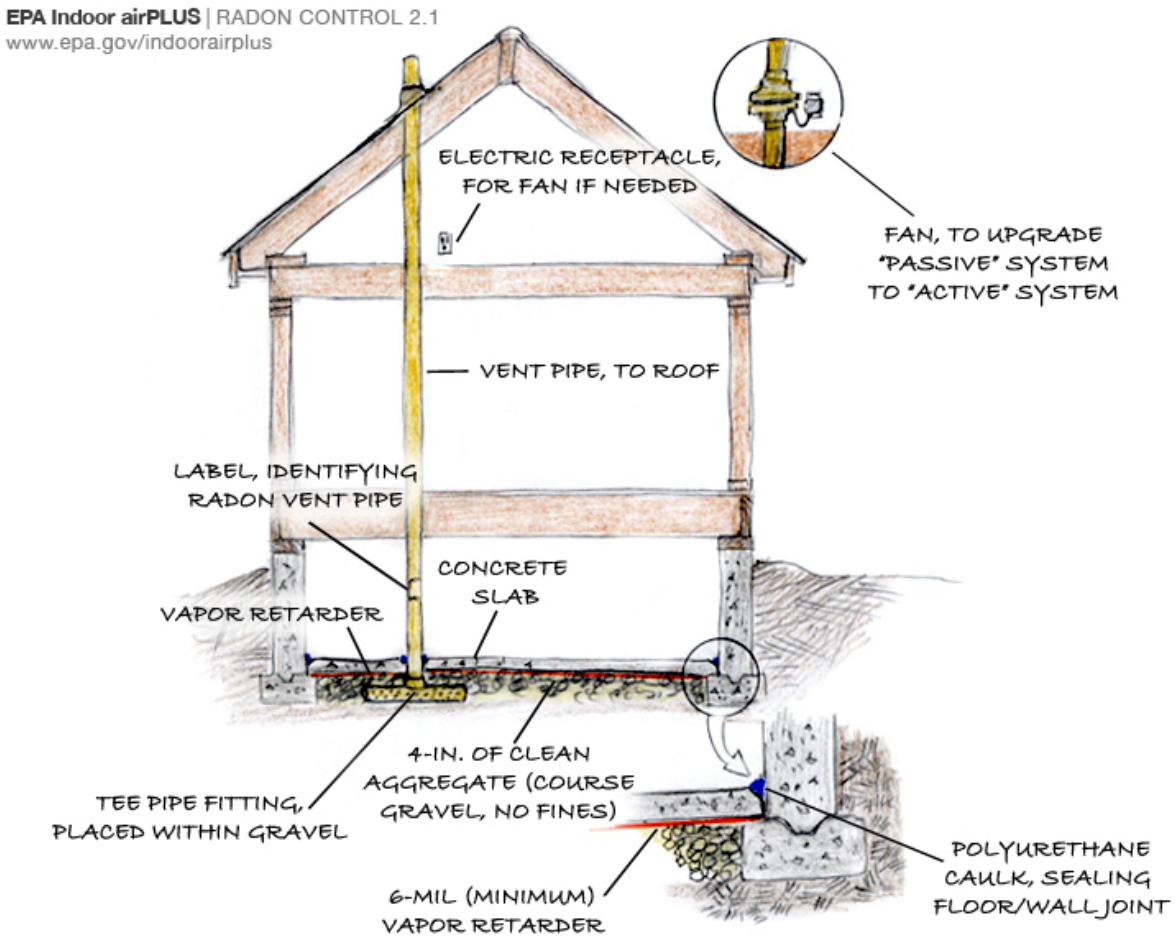
2.1 Radon Control



Surgeon General's Warning:
Radon Causes Lung Cancer

Note: these maps indicate average risk by county. However, High levels of Radon can be found in any home.

2.1 Radon Control



2.1 Radon Resistant Construction

Verification

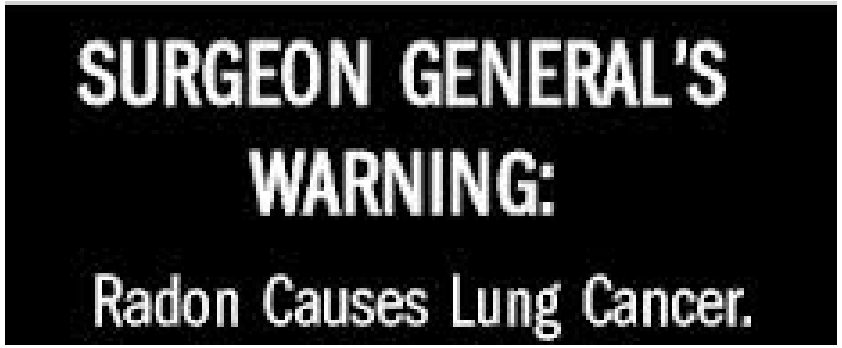
- Can be builder or rater verified.
- **Verify documentation before the start of construction** of an approved radon mitigation system, if required.
- The aggregate layer, connected to a vent pipe, under overlapped polyethylene sheeting should be **visually verified before pouring the slab**.
- The fully connected vent pipe, fan/electrical receptacle, and foundation air sealing should be **visually verified at pre-drywall inspection**.

Section		Requirements (Refer to full Indoor airPLUS Construction Specifications for details)	Must Correct	Builder Verified	Rater Verified	N/A
Radon	2.1	Approved radon-resistant features installed in Radon Zone 1 homes.	☐	☐	☒	☐

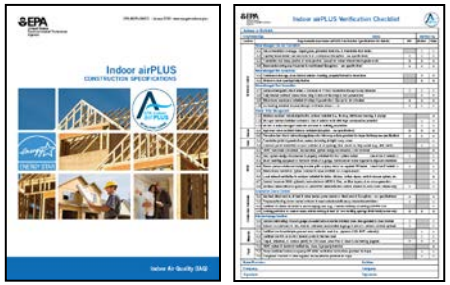
2.1 Radon Control

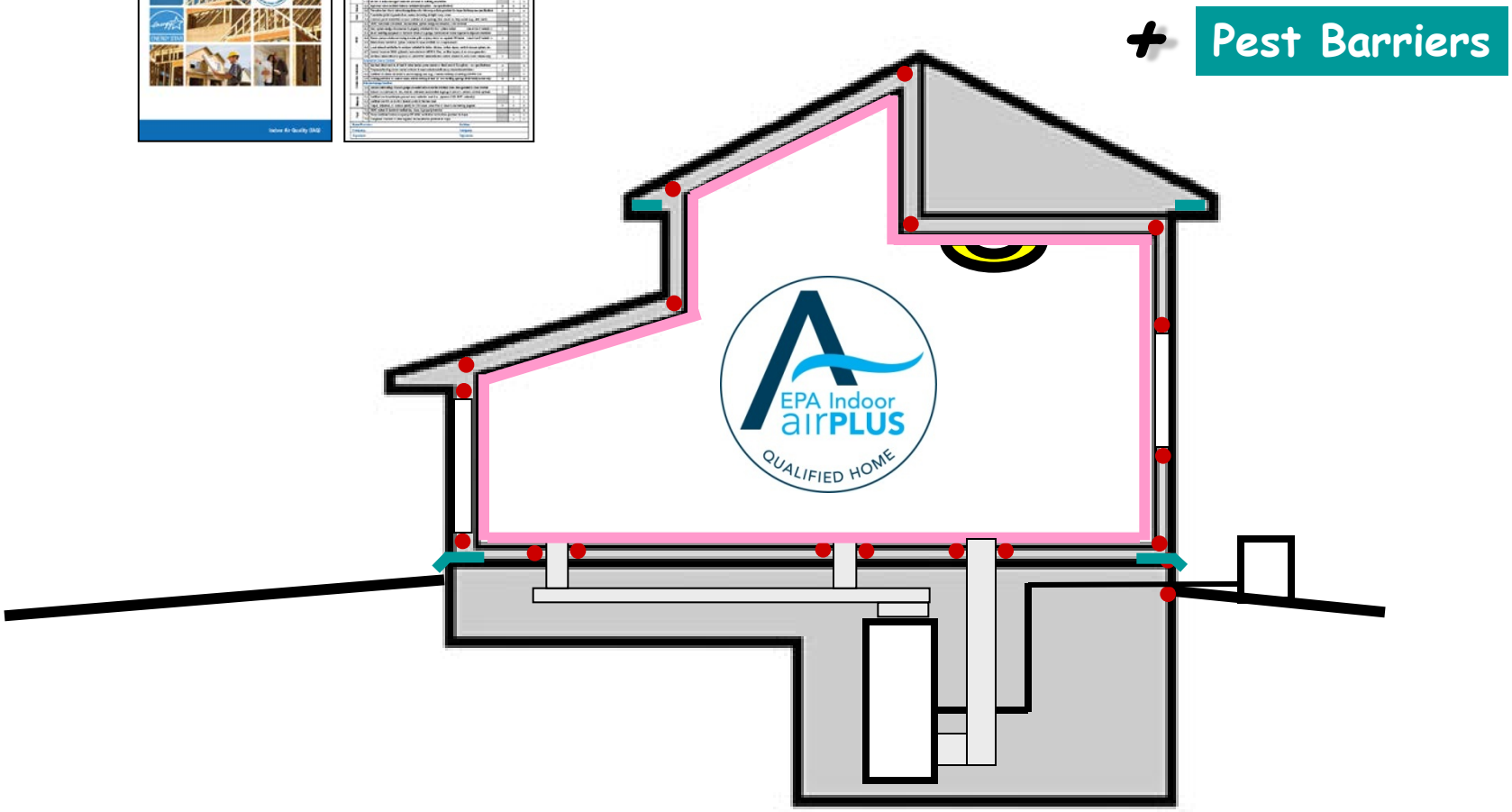
Homeowner Benefits

Protection against radon, the second leading cause of lung cancer in the U.S.



3. Pest Barriers





3. Pest Barriers

3.1 Minimize Pathways for Pest Entry

- *Seal all penetrations and joints between the foundation and exterior wall assemblies.*
- *Air seal all sump covers.*

Advisories:

- **When sealing large gaps use copper or stainless steel wool.**
- **Additional precautions should be taken in areas classified as "Moderate to Heavy" termite infestation.**

3.2 Rodent/Bird Screens

- **Provide corrosion-proof rodent/bird screens for all building openings that cannot be fully sealed and caulked.**

3.2 Rodent/Bird Screens

Verification

- Can be builder or rater verified.
- **Visually verify at final inspection** that all openings are either sealed or covered by a corrosion-proof screen.

Section		Requirements (Refer to full Indoor airPLUS Construction Specifications for details)	Must Correct	Builder Verified	Rater Verified	N/A
Pests	3.2	Corrosion-proof rodent/bird screens installed at all openings that cannot be fully sealed (Exception: dryer vents).	☐	☐	■	

3.2 Rodent/Bird Screens

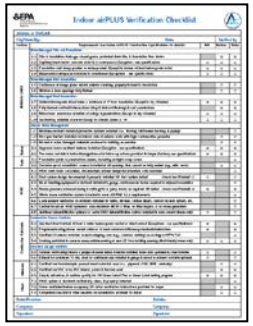
Homeowner Benefits

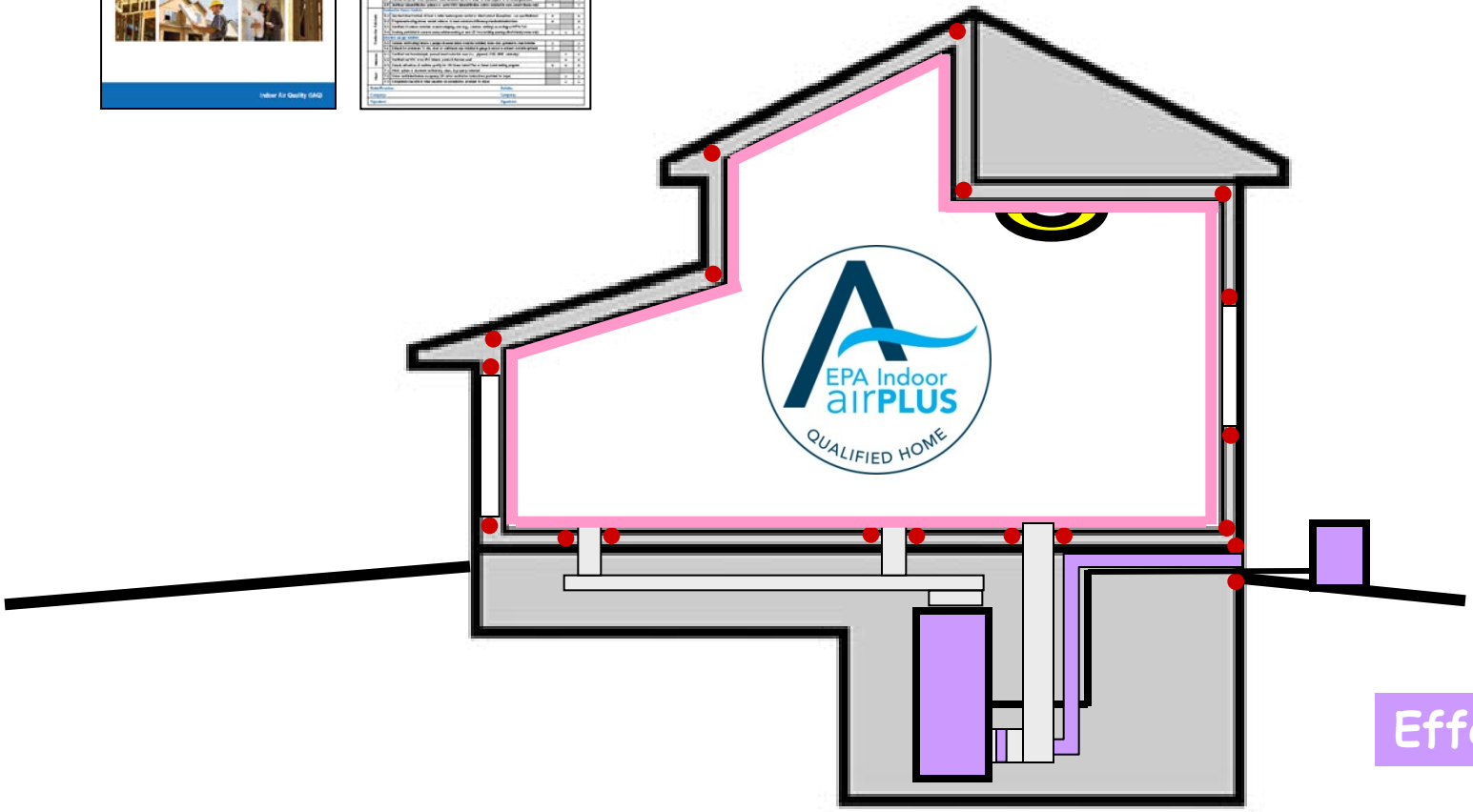
Prevention of potential damage from pests to the home.

Less vacuuming and dusting.

Reduced pest-related allergens and triggers for asthma attacks.

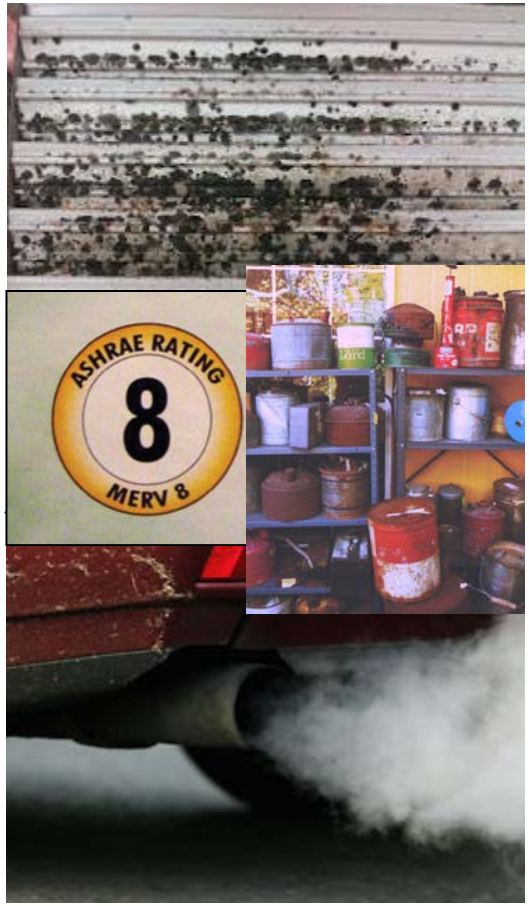
4. HVAC Systems





Effective HVAC

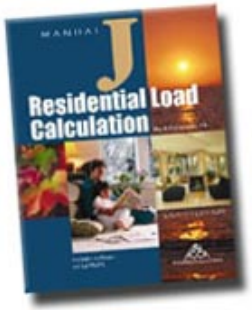
4. HVAC Systems



- 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.

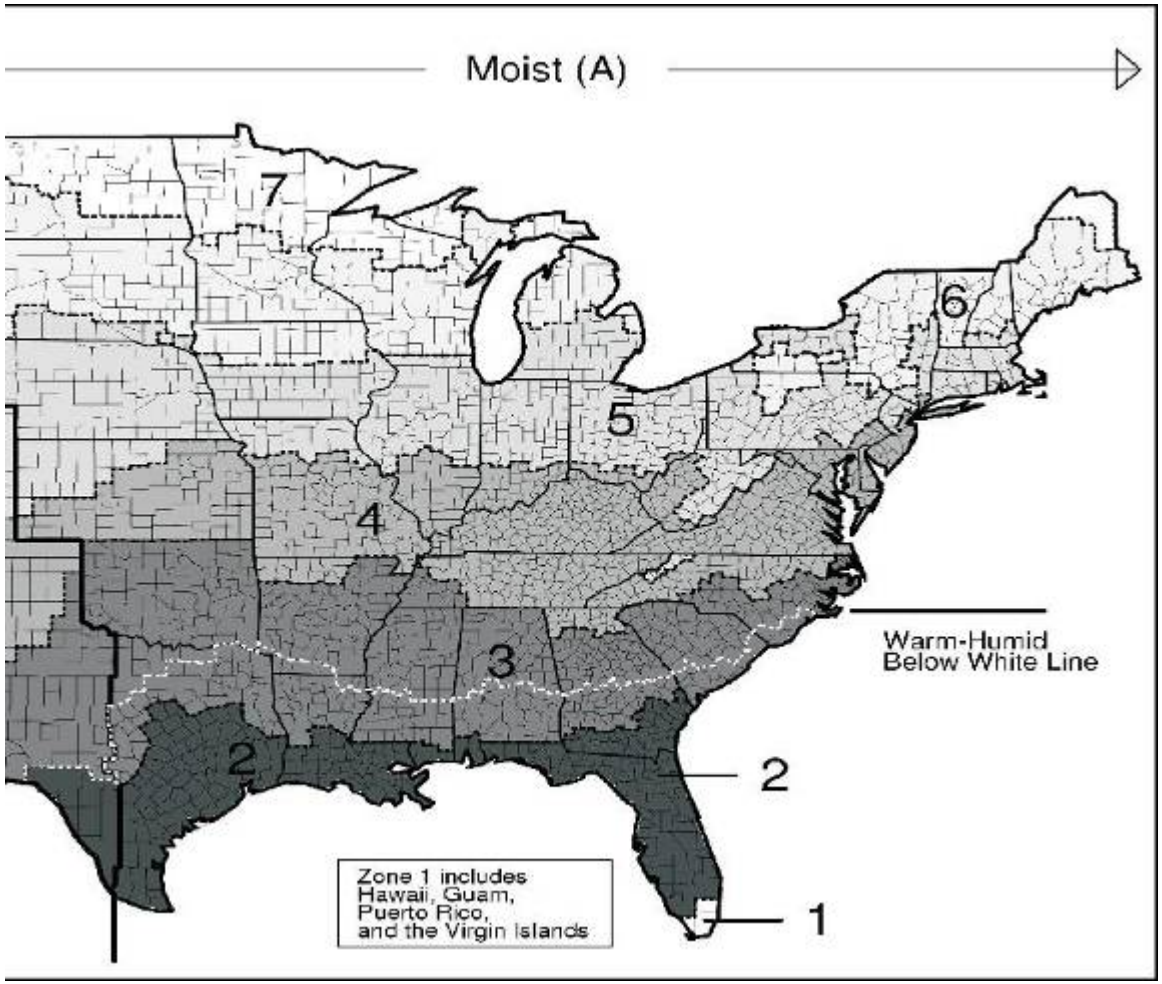
4.1 HVAC Sizing and Design

- *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



Controlled to
≤ 60% RH

4.1 HVAC Sizing and Design

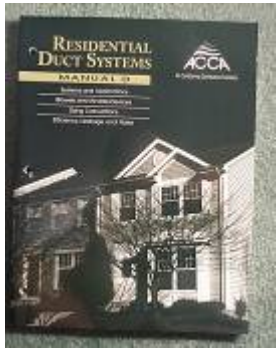
Verification

- 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.

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

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

SEALING WITH MASTIC

4.2 Duct System Design and Installation

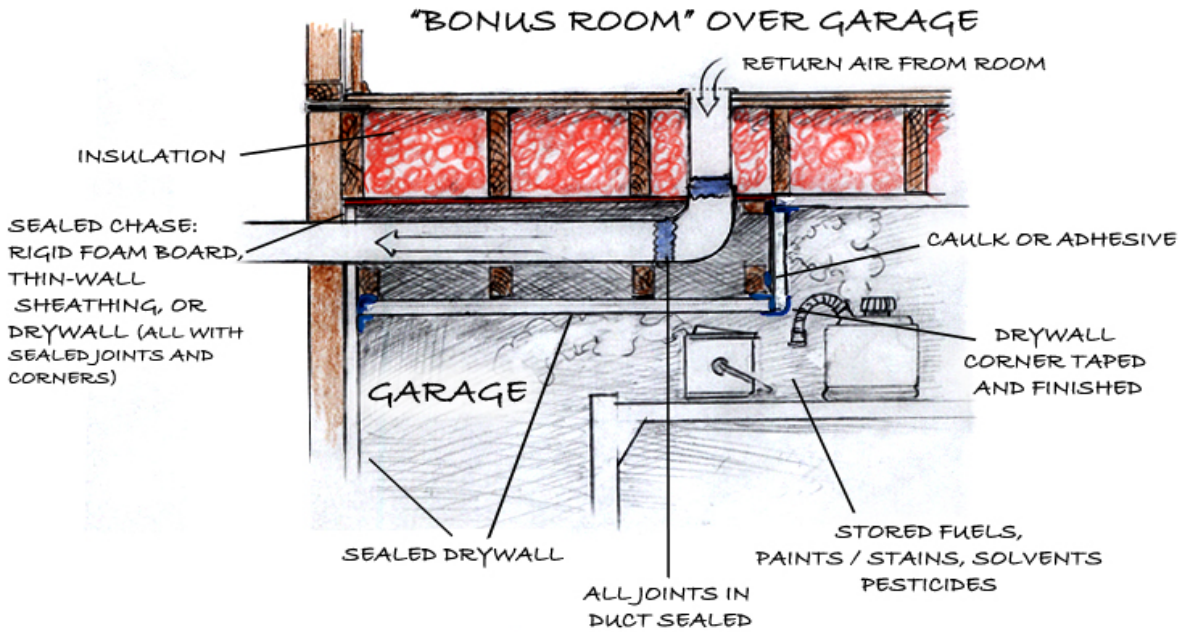
Verification

- Can be builder or rater verified.
- **Visually verify at pre-drywall inspection** that no building cavities are used as part of the forced air system and that all duct openings have been covered.

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

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 or ductwork has been installed in the garage and that any ducts or equipment located in adjacent framing spaces have been separated from the garage space by a continuous air barrier.

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

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

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

Verification

- Can be builder or rater verified.
- **Verify documentation before the start of construction** on the MERV 8 filter to be supplied and **visually verify at final inspection** that the specific filter has been installed.
- **Verify before the start of construction** that the HVAC system has been designed with no ozone-producing air-cleaning equipment.

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

4.1 HVAC Systems

Homeowner Benefits

Reduced exposure to the harmful effects of mold and mildew growth.

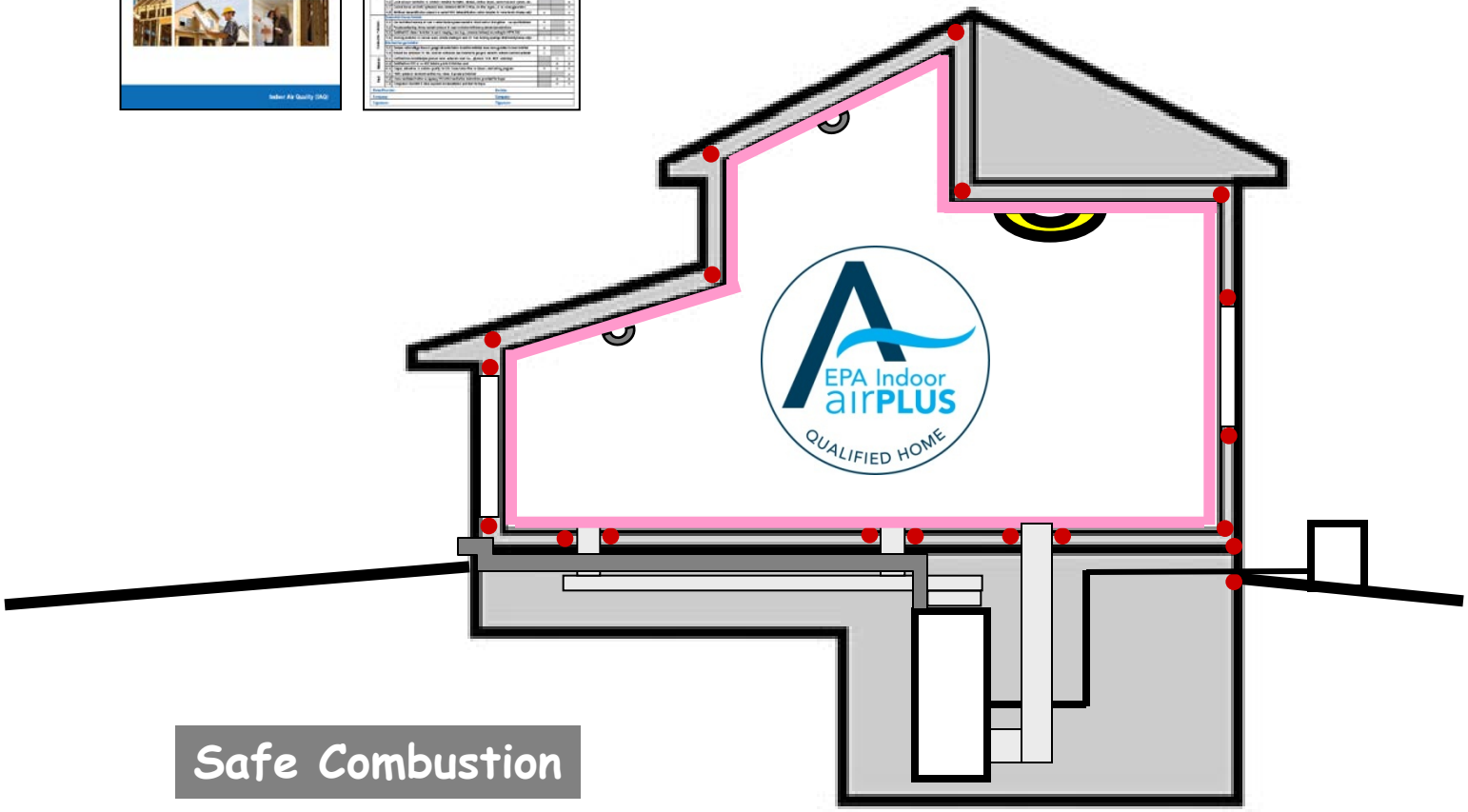
A more comfortable humidity level in the home, year round.

Improved lifespan of building materials and a more durable home.

Helps remove allergens, toxins, irritants and asthma triggers from the home.

House stays cleaner.

5. Combustion Pollutants



Safe Combustion

5. Combustion Pollutants

- Carbon monoxide (CO) poisoning kills an average of 439 persons annually.
- Carbon monoxide, an odorless, colorless gas, which can cause sudden illness and death, is produced any time a fossil fuel is burned.

5.1 Combustion Equipment

- *Mechanically draft or direct vent all gas- and oil-fired furnaces, boilers and water heaters.*
- *Fireplaces that are not mechanically drafted must meet exhaust flow or pressure differential.*

- **Do not install any unvented combustion space-heating appliances.**
- **Ensure naturally drafted fuel-burning appliances compliance with ASHRAE 62.2 or conduct a Worst Case Depressurization Combustion Air Zone (CAZ) Test.**
- **Ensure that all fireplaces and other fuel-burning appliances are vented to the outdoors and supplied with ventilation air.**
- **Meet emissions standards and restrictions for all fuel-burning appliances located in conditioned spaces.**

5.1 Combustion Equipment

POWER VENTED WATER HEATER

DIRECT VENTED FURNACE

5.1 Combustion Equipment

Verification

- Must be rater verified.
- Rater should **verify documentation before the start of construction** that all combustion appliances meet the required emissions standards and **visually verify at final inspection** that the specified equipment has been installed or conduct a combustion air zone test if applicable.

Combustion Pollutants	5.1	Emissions standards met for fuel-burning and space-heating appliances (Exception: see spec).	☐		■	☐
	5.2	CO alarms installed in each sleeping zone (e.g., common hallway) according to NFPA 720.	☐		☐	☐
	5.3	Multifamily buildings: Smoking restrictions implemented AND ETS transfer pathways minimized.	☐	☐	☐	☐
	5.4	Attached garages: Door closer installed on all connecting doors AND 70 cfm exhaust fan installed in garage.	☐		☐	☐

5.2 Carbon Monoxide Alarms

- **All homes with combustion appliance(s) or an attached garage shall have a carbon monoxide (CO) alarm installed in a central location in the immediate vicinity of each separate sleeping zone.**

CO ALARM

COMBINED CO & SMOKE ALARM

5.2 Carbon Monoxide Alarms

Verification

- Must be rater verified.
- Rater should **visually verify at final inspection** that a carbon monoxide alarm has been installed in a central location in the immediate vicinity of each sleeping zone.

Combustion Pollutants	5.1	Emissions standards met for fuel-burning and space-heating appliances (Exception: see spec).	☐		☐	☐
	5.2	CO alarms installed in each sleeping zone (e.g., common hallway) according to NFPA 720.	☐		☐	☐
	5.3	Multifamily buildings: Smoking restrictions implemented AND ETS transfer pathways minimized.	☐	☐	☐	☐
	5.4	Attached garages: Door closer installed on all connecting doors AND 70 cfm exhaust fan installed in garage.	☐		☐	☐

5.3 Multifamily ETS Protections

- **Reduce exposure to environmental tobacco smoke (ETS) in multifamily buildings by:**
  - **Prohibiting smoking in indoor common areas.**
  - **Locating designated outdoor smoking areas.**
  - **Minimizing uncontrolled pathways for ETS transfer between individual dwelling units by sealing walls, ceilings, and floors of dwelling units.**

5.3 Multifamily Environmental Tobacco Smoke Protections

Verification

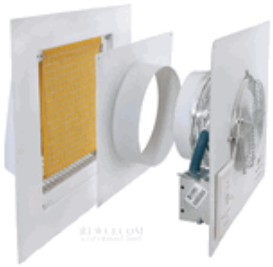
- Can be builder or rater verified.
- **Verify documentation** of prohibited smoking in common areas.
- **Visually verify at pre-drywall inspection** that units have been properly sealed to limit transfer of environmental tobacco smoke.
- **Visually verify at final inspection** the distance of designated smoking areas.

Combustion Pollutants	5.1	Emissions standards met for fuel-burning and space-heating appliances (Exception: see spec).	☐		■	☐
	5.2	CO alarms installed in each sleeping zone (e.g., common hallway) according to NFPA 720.	☐		■	☐
	5.3	Multifamily buildings: Smoking restrictions implemented AND ETS transfer pathways minimized.	☐	■	☐	☐
	5.4	Attached garages: Door closer installed on all connecting doors AND 70 cfm exhaust fan installed in garage.	☐		☐	☐

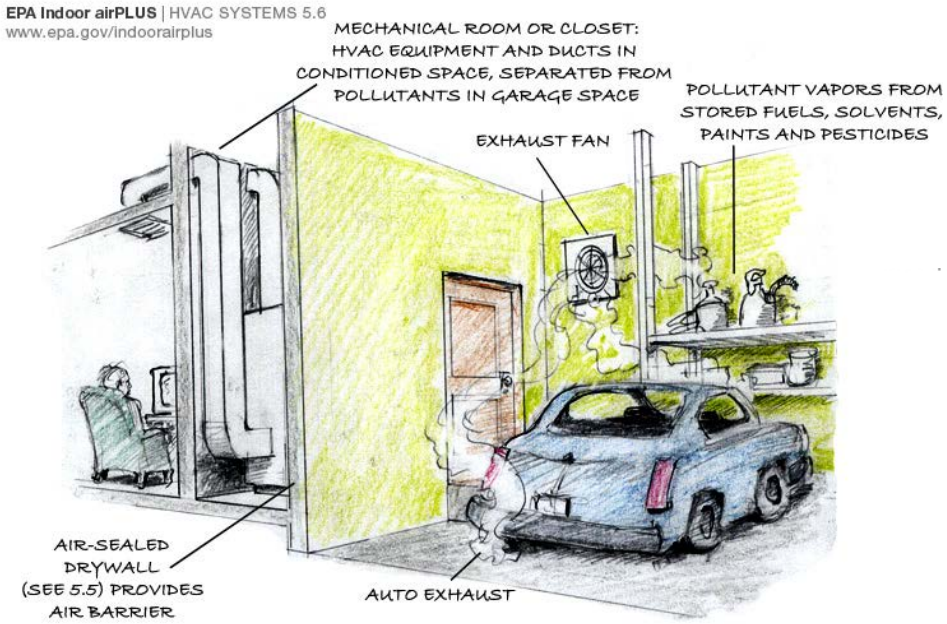
5.4 Attached Garages

- *Isolate attached garages from conditioned spaces:*
  - *Air-seal common walls and ceilings.*
  - *Use weather stripping on all doors between living spaces and attached garages.*

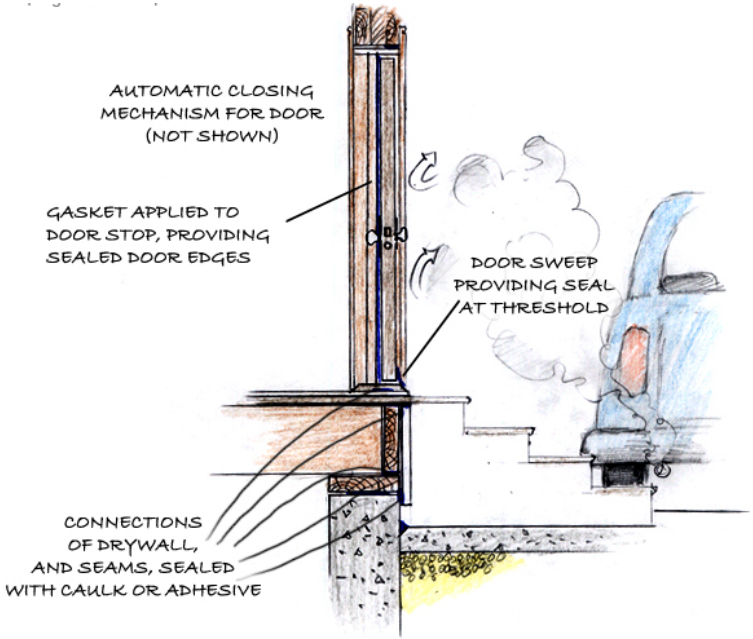
- **Install an automatic door closer on all doors between living spaces and attached garages.**
- **Equip each attached garage with an exhaust fan with a minimum installed capacity of 70 cfm.**
  - **Wire each exhaust fan for continuous operation or with automatic fan controls.**



5.4 Attached Garages



PROVIDE EXHAUST FAN TO REMOVE GARAGE POLLUTANTS



AIR-SEALED WALL (AND CEILING WHEN LIVING SPACE OVER GARAGE) SEPARATING GARAGE POLLUTANTS FROM LIVING SPACES (SEE ALSO 4.3)

5.4 Attached Garages

Verification

- Must be rater verified.
- Rater should **verify at final inspection** proper functioning of the automatic door closer.
- Rater should **visually verify at final inspection** the installed garage ventilation system.
- If the garage is ventilated by a ducted fan a rater should perform a flow test to confirm the required CFM is being met.

Combustion Pollutants	5.1	Emissions standards met for fuel-burning and space-heating appliances (Exception: see spec).	☐		■	☐
	5.2	CO alarms installed in each sleeping zone (e.g., common hallway) according to NFPA 720.	☐		■	☐
	5.3	Multifamily buildings: Smoking restrictions implemented AND ETS transfer pathways minimized.	☐	■	☐	☐
	5.4	Attached garages: Door closer installed on all connecting doors AND 70 cfm exhaust fan installed in garage.	☐		■	☐

5.2 Combustion Pollutants

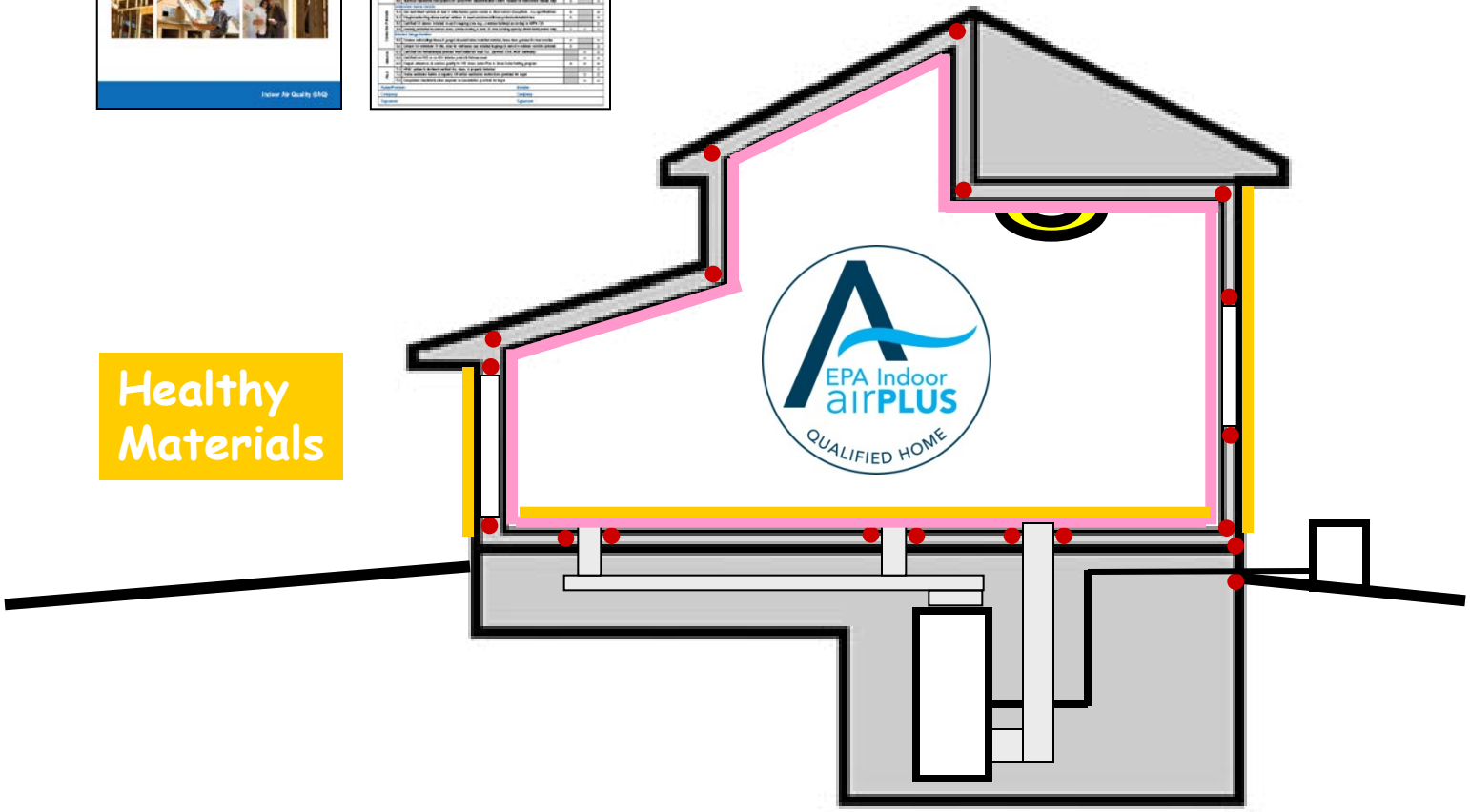
Benefits

Reduced exposure to carbon monoxide.

Prevention of toxins leaking from the garage into the home.

Round-the-clock peace of mind.

6. Low Emission Materials



Healthy Materials

6. Low Emission Materials

- Indoor levels of many chemical pollutants can be 2-5 times higher than outdoor levels.

- VOCs include a variety of chemicals, some of which may have short- and long-term adverse health effects, including eye, nose, and throat irritation, headaches, loss of coordination, nausea, damage to liver, kidney, and central nervous system.

6.1 Composite Wood

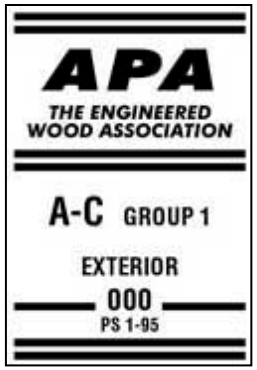
- *Use plywood and OSB compliant with PS1 or PS2, and made with moisture-resistant adhesives as indicated by the American Plywood Association (APA) trademark.*

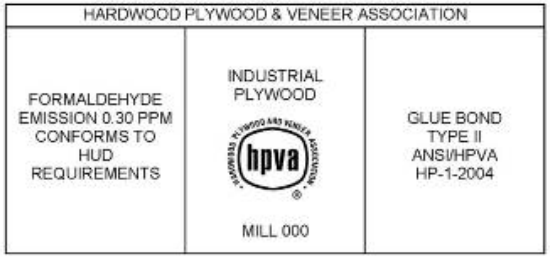
- *Use hardwood plywood products compliant with ANSI/HPVA and U.S. HUD Title 24, OR CA Title 17.*

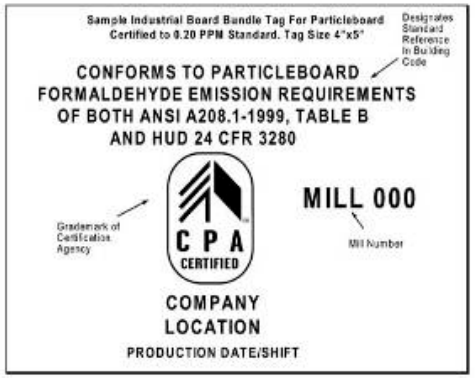
- *Use particleboard and MDF products compliant with ANSI A208.1 and A208.2, and U.S. HUD Title 24, OR CPA Grademark certification program, OR CA Title 17.*

- *Install only cabinetry made with component materials that meet all the standards above OR registered products produced in plants certified under KCMA's Environmental Stewardship Certification Program (ESP 05-12).*

6.1 Composite Wood







6.1 Composite Wood

Verification

- Can be builder or rater verified.
- **Verify documentation before the start of construction** that the composite wood materials supplied will meet the required emissions standards.

Section		Requirements (Refer to full Indoor airPLUS Construction Specifications for details)	Must Correct	Builder Verified	Rater Verified	N/A
Materials	6.1	Certified low-formaldehyde composite wood materials AND structural plywood AND OSB PS1 or PS2 compliant.	☐	■	☐	
	6.2	Certified low-VOC or no-VOC interior paints and finishes used.	☐	☐	☐	
	6.3	Carpet, carpet adhesives CRI Green Label Plus AND carpet cushion CRI Green Label.	☐	☐	☐	☐

6.2 Interior Paints and Finishes

- *Use interior paints and finishes certified as low-VOC or no-VOC*
  - *Greenseal GS11*
  - *Greenguard*
  - *Scientific Certification Systems*
  - *Master Painters Institute*
  - *Verified using CA 01350(CDPH Standard Method V1.1-2010).*

6.2 Interior Paints and Finishes Verification

- Can be builder or rater verified.
- **Verify documentation before the start of construction** that the paints and finishes supplied will meet the required emissions standards.

Section		Requirements (Refer to full Indoor airPLUS Construction Specifications for details)	Must Correct	Builder Verified	Rater Verified	N/A
Materials	6.1	Certified low-formaldehyde composite wood materials AND structural plywood AND OSB PS1 or PS2 compliant.	☐	■	☐	
	6.2	Certified low-VOC or no-VOC interior paints and finishes used.	☐	■	☐	
	6.3	Carpet, carpet adhesives CRI Green Label Plus AND carpet cushion CRI Green Label.	☐	☐	☐	☐

6.3 Carpets and Carpet Adhesives

- Use carpets and carpet adhesives labeled with the Carpet and Rug Institute (CRI) Green Label Plus testing program criteria.
- For carpet cushion (i.e., padding), use only products certified to meet the CRI Green Label testing program criteria.

6.3 Carpets and Carpet Adhesives

Verification

- Can be builder or rater verified.
- **Verify documentation before the start of construction** that the carpet and carpet adhesives supplied will meet the required emissions standards.

Section		Requirements (Refer to full Indoor airPLUS Construction Specifications for details)	Must Correct	Builder Verified	Rater Verified	N/A
Materials	6.1	Certified low-formaldehyde composite wood materials AND structural plywood AND OSB PS1 or PS2 compliant.	☐	■	☐	
	6.2	Certified low-VOC or no-VOC interior paints and finishes used.	☐	■	☐	
	6.3	Carpet, carpet adhesives CRI Green Label Plus AND carpet cushion CRI Green Label.	☐	■	☐	☐

6.3 Carpets and Carpet Adhesives

Homeowner Benefits

- Less “chemical” smell.
- Lowered exposure to VOCs.
- Reduced potential for occupant health complaints.

7. Home Commissioning

7.1 HVAC and Duct Verification

- *Verify that HVAC systems and ductwork are installed according to their design.*

- **Inspect ductwork to verify it is dry and substantially free of dust or debris. If duct openings were not covered during construction, thoroughly vacuum out each opening.**
- **Inspect air-handling equipment and verify that heat exchangers/coils are free of dust AND the filter is new, clean and meets specified MERV rating.**

7.1 HVAC and Duct Verification

Verification

- Can be builder or rater verified.
- **Visually verify at final inspection** that the ductwork and air-handling equipment is substantially free of dust and debris.

Section		Requirements (Refer to full Indoor airPLUS Construction Specifications for details)	Must Correct	Builder Verified	Rater Verified	N/A
Final	7.1	HVAC system and ductwork verified to be dry and clean AND new filter installed.	☐	☐	☐	
	7.2	Home ventilated before occupancy.	☐	☐	☐	☐
	7.3	Completed checklist and other required documentation provided for buyer.	☐	☐	☐	☐

7.2 Ventilation after Material Installation

- **Verify that the home has been ventilated with outside air:**
  - **During and shortly after installing products that are known sources of contaminants, AND**
  - **During the period between finishing and occupancy.**

7.2 Ventilation after Material Installation

Verification

- Can be builder or rater verified.
- The builder is encourage to **maintain a record** of when ventilation of the home is performed prior to occupancy.

Section		Requirements (Refer to full Indoor airPLUS Construction Specifications for details)	Must Correct	Builder Verified	Rater Verified	N/A
Final	7.1	HVAC system and ductwork verified to be dry and clean AND new filter installed.	☐	☐	■	
	7.2	Home ventilated before occupancy.	☐	■	☐	☐
	7.3	Completed checklist and other required documentation provided for buyer.	☐	☐	☐	☐

7.3 Buyer Information Kit

- **Provide buyers with information and documentation of the home's IAQ protections, including:**
  - **A copy of the Indoor airPLUS Verification Checklist.**
  - **HVAC, duct, and ventilation system design documentation.**
  - **Operations and maintenance instruction manuals for all installed equipment and systems addressed by Indoor airPLUS and ENERGY STAR requirements.**

7.3 Buyer Information Kit

Verification

- Can be builder or rater verified.
- The builder should **retain a copy** of the buyer information kit provided to the homebuyer.

Section		Requirements (Refer to full Indoor airPLUS Construction Specifications for details)	Must Correct	Builder Verified	Rater Verified	N/A
Final	7.1	HVAC system and ductwork verified to be dry and clean AND new filter installed.	☐	☐	■	
	7.2	Home ventilated before occupancy.	☐	■	☐	☐
	7.3	Completed checklist and other required documentation provided for buyer.	☐	■	☐	☐

Sign and Date

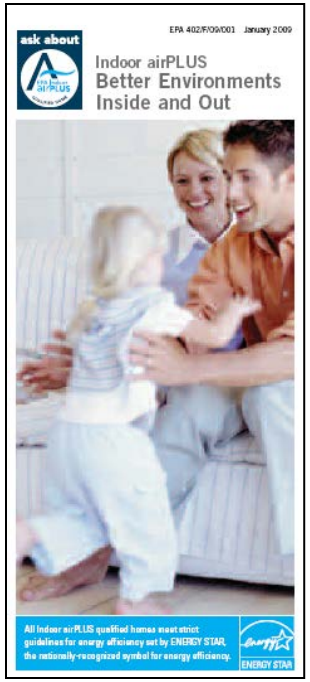
The Rater who conducted the verification, or a responsible party from the Rater's company, must sign the completed verification checklist. The builder must sign the checklist if any items in the "Builder Verified" column are checked, and by so doing accepts full responsibility for verifying that those items meet Indoor airPLUS requirements.

Rater Company: _____	Builder Company: _____
Rater Employee: _____	Builder Employee: _____
Rater Signature: _____ Date: _____	Builder Signature: _____ Date: _____

Resources and Tools

www.epa.gov/indoorairplus

Marketing and Technical Support for Partners



- Builder and consumer resources.
- Partner locator.
- Website widgets.
- Construction requirements.
- Technical guidance.

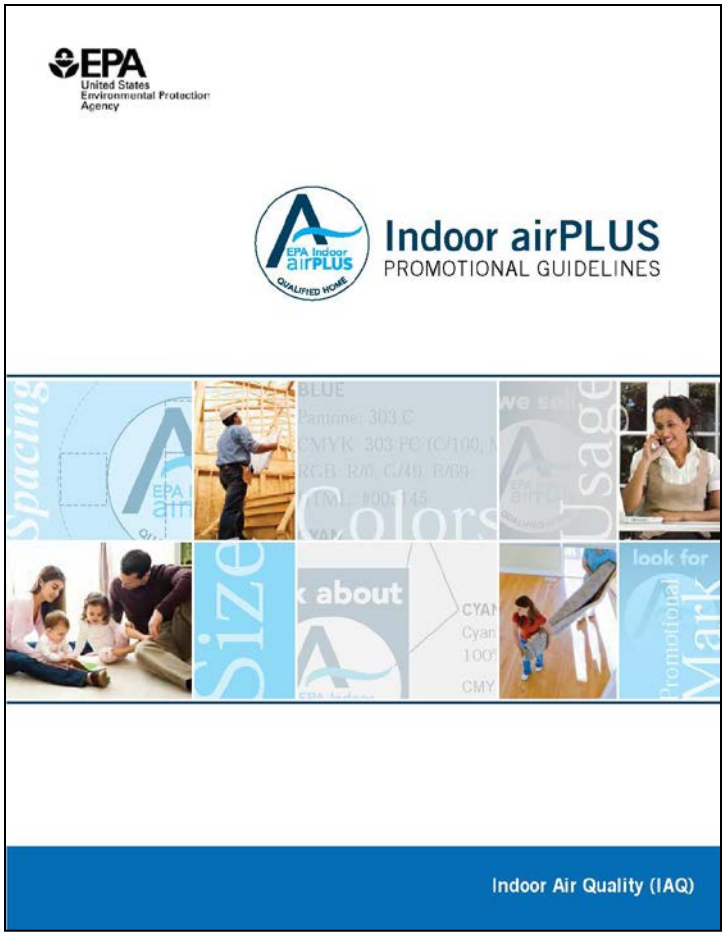
Resources and Tools

Get the latest information:

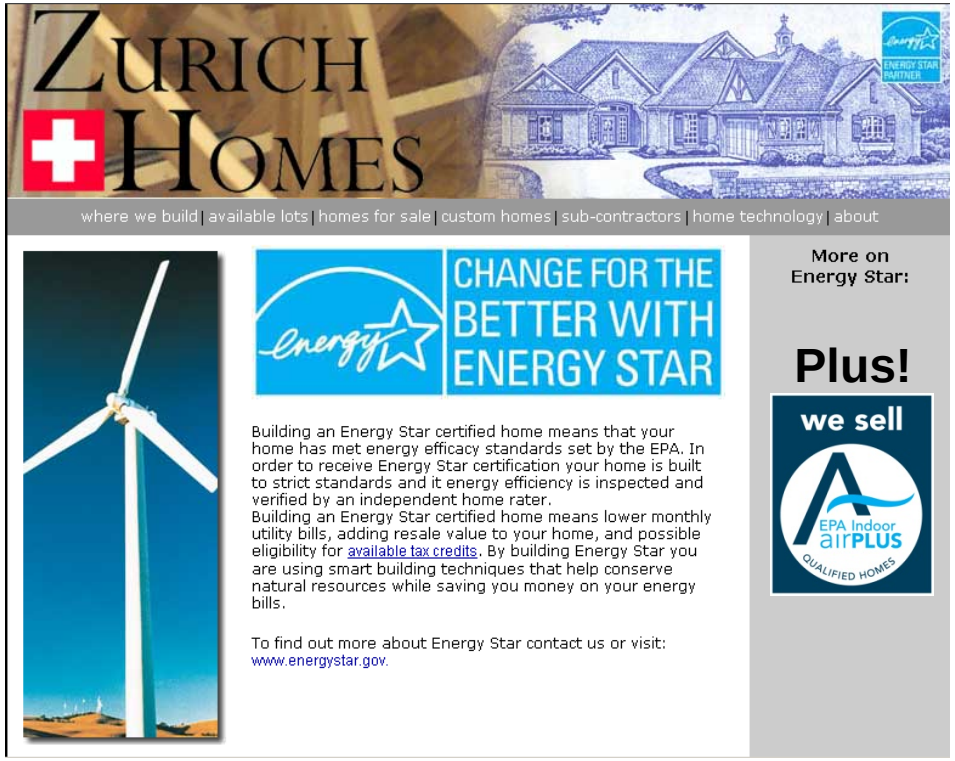
- Facebook
- Twitter
- YouTube Videos
- Mobile App
- Podcasts

Promotional Guidelines

- Using Indoor airPLUS to maintain and build value.
- Using Indoor airPLUS marks.
- Using Indoor airPLUS with complementary programs.
- Indoor airPLUS general guidelines.
- Indoor airPLUS graphic technical guidelines.
- Incorrect usage.



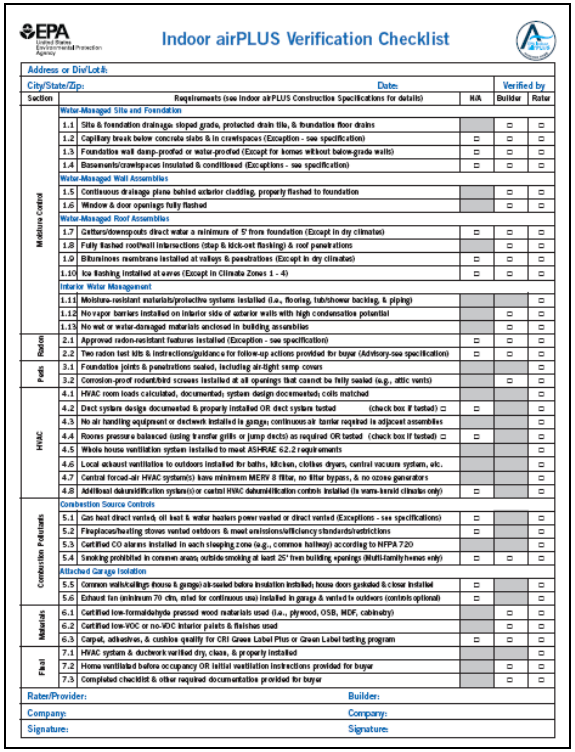
Indoor airPLUS Marks and Messaging



Become a Partner

Step 1: Review Materials

Visit: www.epa.gov/indoorairplus



EPA United States Environmental Protection Agency

Indoor airPLUS Verification Checklist

Address or Div/Lot#:

City/State/Zip: Date: Verified by

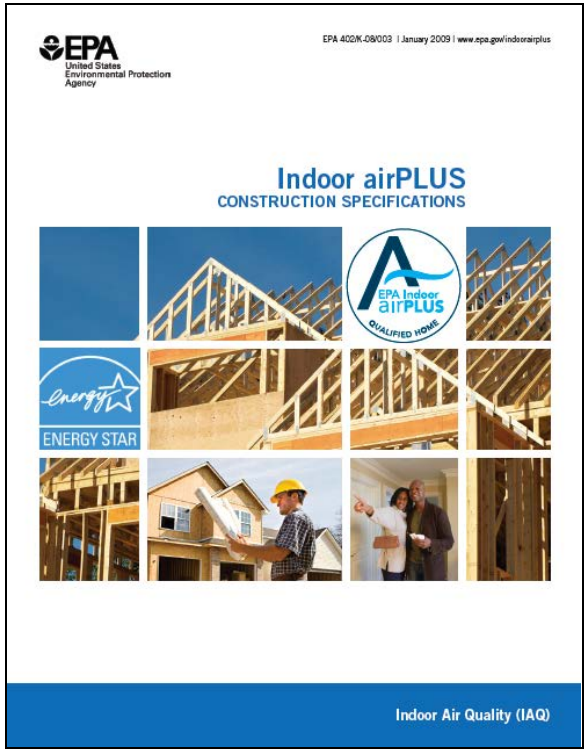
Section		Requirements (see Indoor airPLUS Construction Specifications for details)	N/A	Builder	Rater
Moisture Control		**Water-Managed Site and Foundation**			
	1.1	Site & foundation drainage: sloped grade, protected drain tile, & foundation floor drains		☐	☐
	1.2	Capillary break below concrete slabs & in crawlspaces (Exception - see specification)	☐	☐	☐
	1.3	Foundation wall damp-proofed or water-proofed (Except for homes without below-grade walls)	☐	☐	☐
	1.4	Basements/crawlspaces insulated & conditioned (Exceptions - see specification)	☐	☐	☐
		Water-Managed Wall Assemblies			
	1.5	Continuous drainage plane behind exterior cladding, properly flashed to foundation		☐	☐
	1.6	Window & door openings fully flashed		☐	☐
		Water-Managed Roof Assemblies			
	1.7	Gutters/downspouts direct water a minimum of 5' from foundation (Except in dry climates)	☐	☐	☐
	1.8	Fully flashed roof/wall intersections (step & kick-out flashing) & roof penetrations		☐	☐
	1.9	Bituminous membrane installed at valleys & penetrations (Except in dry climates)	☐	☐	☐
	1.10	Ice flashing installed at eaves (Except in Climate Zones 1 - 4)	☐	☐	☐
		Interior Water Management			
	1.11	Moisture-resistant materials/protective systems installed (i.e., flooring, tub/shower backing, & piping)			☐
	1.12	No vapor barriers installed on interior side of exterior walls with high condensation potential		☐	☐
	1.13	No wet or water-damaged materials enclosed in building assemblies		☐	☐
Radon	2.1	Approved radon-resistant features installed (Exception - see specification)	☐	☐	☐
	2.2	Two radon test kits & instructions/guidance for follow-up actions provided for buyer (Advisory-see specification)	☐	☐	☐
Pests	3.1	Foundation joints & penetrations sealed, including air-tight sump cover			☐
	3.2	Corrosion-proof rodent/bird screens installed at all openings that cannot be fully sealed (e.g., attic vents)		☐	☐
HVAC	4.1	HVAC room loads calculated, documented; system design documented; coils matched			☐
	4.2	Duct system design documented & properly installed OR duct system tested (check box if tested) ☐	☐		☐
	4.3	No air handling equipment or ductwork installed in garage; continuous air barrier required in adjacent assemblies			☐
	4.4	Rooms pressure balanced (using transfer grills or jump ducts) as required OR tested (check box if tested) ☐	☐		☐
	4.5	Whole house ventilation system installed to meet ASHRAE 62.2 requirements			☐
	4.6	Local exhaust ventilation to outdoors installed for baths, kitchen, clothes dryers, central vacuum system, etc.			☐
	4.7	Central forced-air HVAC system(s) have minimum MERV 8 filter, no filter bypass, & no ozone generators			☐
	4.8	Additional dehumidification system(s) or central HVAC dehumidification controls installed (in warm-humid climates only)	☐		☐
Combustion Pollutants		**Combustion Source Controls**			
	5.1	Gas heat direct vented; oil heat & water heaters power vented or direct vented (Exceptions - see specifications)	☐		☐
	5.2	Fireplaces/heating stoves vented outdoors & meet emissions/efficiency standards/restrictions	☐		☐
	5.3	Certified CO alarms installed in each sleeping zone (e.g., common hallway) according to NFPA 720			☐
	5.4	Smoking prohibited in common areas; outside smoking at least 25' from building openings (Multi-family/homes only)	☐	☐	☐
		Attached Garage Isolation			
	5.5	Common walls/ceilings (house & garage) air-sealed before insulation installed; house doors gasketed & closer installed	☐		☐
	5.6	Exhaust fan (minimum 70 cfm, rated for continuous use) installed in garage & vented to outdoors (controls optional)	☐		☐
Materials	6.1	Certified low-formaldehyde pressed wood materials used (i.e., plywood, OSB, MDF, cabinetry)		☐	☐
	6.2	Certified low-VOC or no-VOC interior paints & finishes used		☐	☐
	6.3	Carpet, adhesives, & cushion qualify for CRI Green Label Plus or Green Label testing program	☐	☐	☐
Final	7.1	HVAC system & ductwork verified dry, clean, & properly installed			☐
	7.2	Home ventilated before occupancy OR initial ventilation instructions provided for buyer		☐	☐
	7.3	Completed checklist & other required documentation provided for buyer		☐	☐

Rater/Provider: Builder:

Company: Company:

Signature: Signature:

Verification Checklist



EPA 402/K-08/003 | January 2009 | www.epa.gov/indoorairplus

EPA United States Environmental Protection Agency

Indoor airPLUS
CONSTRUCTION SPECIFICATIONS

Indoor Air Quality (IAQ)

Construction Specifications

look for EPA Indoor airPLUS QUALIFIED HOME

Indoor Air Quality (IAQ)

Step 2: Sign the Partnership Agreement

Visit: www.epa.gov/indoorairplus

- Click “Join Now”
- Determine partner category:
  - Homebuilder
  - Rater/Provider
  - Ally
- Fill out fields
- Review terms of agreement
- Click “Submit”

Step 3: Build & Label Homes

Rater Inspects Home Using Verification Checklist

EPA United States Environmental Protection Agency

Indoor airPLUS Verification Checklist

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City/State/Zip: Date:

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Rater/Provider: Builder:

Company: Company:

Signature: Signature:

Place the label adjacent to the ENERGY STAR label

look for EPA Indoor airPLUS QUALIFIED HOMES

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

Indoor airPLUS

For more information and to sign up as a partner:
www.epa.gov/indoorairplus

Contact the Indoor airPLUS Team at:
indoor_airPLUS@epa.gov

Presenters:

James Ball, Cadmus Group
james.ball@cadmusgroup.com
703-247-6165

Bob Axelrad, EPA
axelrad.bob@epa.gov
202-343-9315