INDOOR AIR QUALITY

How Do You Spell IAQ?

BY HOME ENERGY MAGAZINE

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Homeowners spend billions of dollars per year on “air cleaning” products, some of which actually add more pollutants to their indoor air! People buy these products because they promise to provide clean air. Few builders make this promise. Yet careful design and construction of a new home is much more likely to improve indoor air quality (IAQ) than any consumer product. Furthermore, surveys indicate that home buyers are willing to pay up to $5,000 more for homes with IAQ improvements. It’s clear that consumers are concerned about IAQ and are willing to pay for it.

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Poor IAQ conditions in homes, including dampness and mold, particulates, and chemicals, are associated with a host of health problems. These include eye irritation, headaches, allergies, and asthma. Formaldehyde, benzene, and radon exposure have been linked to cancer. CO poisoning can also be deadly, and has been linked to health risks at lower exposures. And the list goes on.

Poor IAQ can prove expensive for builders. In a traditionally cost-competitive business, the cost of servicing comfort complaints and other IAQ-related callbacks can have a significant impact on the bottom line. Construction defect litigation associated with mold and other IAQ problems poses an additional risk. And the rising cost of liability insurance coverage takes its toll on the bottom line as well. Overall, problems caused by poor IAQ have cost builders billions of dollars in recent years.

What Is Good IAQ?

People get sick when they are exposed to pollutants at concentrations above the thresholds that their individual bodies can handle. But in every home there are thousands of sources of pollutants, at a wide range of concentrations. Whether these pollutant concentrations result in unhealthy exposures depends on many factors. These factors include source strength (the amount of each pollutant emitted by each source in the house); whether the house has a ventilation system, and if so, how effective it is; how equipment and appliances interact; the airtightness of the building envelope; the weather; occupant behavior; and so on. And different people's bodies handle pollutants differently—some bodies tolerate higher exposures than others. All this is complicated even further by the fact that people are also exposed to pollutants outside their homes. Consequently, it would be very difficult to predict whether a particular individual, in a particular house, will suffer from "bad" IAQ.

However, this doesn't mean that it's impossible to get good IAQ. Researchers have learned which pollutants to be most concerned about, and we have learned best practices for minimizing exposure to those pollutants. Radon, mold and moisture, CO, particulates, and toxic chemicals commonly found in homes (such as formaldehyde) are all documented health risks. Exposure to each can be lowered through good IAQ design.

Which IAQ Features Matter?

Some major IAQ risks are not covered in green building programs. Dampness and mold have been associated with a 30%–50% increase in asthma-related symptoms, and building professionals know a lot about how to control moisture in buildings. Yet no green building programs I am aware of require a comprehensive and measurable approach to moisture control.

Radon is another example of a known serious IAQ health risk for which affordable reduction techniques, such as radon-resistant new construction (RRNC), are available. And yet RRNC techniques are not required in many green building programs. I am not aware of any green

building program in the United States that requires RRNC outside EPA radon zone 1, yet the radon cancer risk in zone 2 is significant.

These are just two of the many IAQ risks often ignored by builders who don't really know what makes for good IAQ in homes. To address these uncertainties, and to provide builders with a recognized standard for IAQ, EPA has added an IAQ segment to the already well-known Energy Star program—the Energy Star Indoor Air Package (IAP).

Defining IAQ features that significantly reduce risk is especially important now as the building industry rapidly moves to adopt green building programs. By identifying affordable best practices for improving IAQ in new homes, and by collaborating with green building program leaders to incorporate these practices into their programs, EPA is helping builders and home buyers to address their IAQ concerns. The IAP program gives builders and buyers easy access to sound and consistent guidance, and provides a simple label to identify houses that meet this improved performance level.

With the Energy Star Indoor Air Package, forward-thinking builders can reduce risks to their customers and their business, while they distinguish themselves in the new home market. With the IAP label, they can legitimately claim that their homes meet voluntary EPA guidelines for improved IAQ and energy efficiency. Labeled homes include "best practice" features designed to lower exposure to the most common indoor air pollutants, reducing known health risks, including all those listed above. Each of the IAP specifications was developed based on the best available science concerning the risks associated with bad IAQ. And each of these specifications was developed with an eye to practical considerations, including cost, builder production process, and enforceability. The initial specifications were piloted in Denver, Colorado, and were recently revised based on input from the field. The IAP specifications and labeling program are now available for interested Energy Star Partners nationwide.

IAP Verification and Labeling

The IAP label is delivered through the growing Energy Star verification infrastructure, by certified home energy rating system (HERS) raters or the equivalent. HERS raters will help builders to evaluate the IAP specifications, to determine whether they wish to participate—just as they do for Energy Star. Once they decide to participate, builders will build homes to meet the Energy Star and IAP specifications. HERS raters will then conduct inspections to verify that the homes comply before labeling them—again, just as they do for Energy Star.

Raters use the IAP verification checklist during the two Energy Star verification inspections (that is, pre-drywall and final). With no additional site visits, IAP verification was designed to add little to the cost of inspection. Raters simply bring the IAP verification checklist along

with them when they conduct the new Energy Star for Homes Thermal Bypass checklist, and again during final inspection and testing.

With the IAP label, Energy Star partners can get even more recognition for their Energy Star-qualified homes. Not only can these partners legitimately claim high energy performance with Energy Star, but they can also prove that they are a step ahead of their competition with verified IAQ features. Builders who participate in the IAP program will be able to use the IAP cobrand and special IAP marketing materials. These are similar to the Energy Star marketing materials, but they focus on the many benefits of the IAQ features.

IAP was also designed to be compatible with green building programs, by providing a standard package of IAQ credits. IAP has already been incorporated into the U.S. Green Building Council's LEED for Homes program, as an IAP path to the indoor environmental quality (IEQ) credit requirements. Other green building programs can also adopt the IAP specifications as a simple and verifiable IAQ requirement for their programs. Energy Star qualification is already a starting requirement for some green building programs. IAP is the next logical step toward sustainability.

Four Criteria

With the Indoor Air Package, EPA is challenging builders to step up to a new level of quality by building homes with a comprehensive set of IAQ design and construction features. However, these specifications are not pie in the sky. EPA carefully developed the requirements to meet the four balanced criteria described below.

1. ***Science-based.*** The IAP specifications are justified based on known health risks posed by a pollutant source. Where possible, the specs are justified based on documented health risk reductions attributable to appropriate measures, or on well-established engineering best practices. Documenting health risk reductions is easier said than done, since there is a lot of scientific uncertainty about IAQ health risks. Where there are insufficient data to justify a specific measure, engineering best practices are specified. This criterion strikes a balance between the precautionary principle, which states that we should minimize exposure to known toxic substances even if we can't quantify the risk of injury, and professional judgment about the feasibility of switching to new technologies or techniques.
2. ***Affordable.*** The IAP specifications are based on affordable and available technology. This same goal guided the EPA during the development of the Energy Star New Homes program. The Energy Star program was designed to encourage the purchase of available energy-efficient products that perform better than average products in their class. The same criterion was applied in the development of the IAP specifications. The program is not designed to encourage the use of untested products or technologies. The technology required to implement every IAP specification can be found in the market today, and the specs were developed with an eye to the total anticipated incremental

cost of implementation.

3. ***Compatible with builder processes.*** The IAP specifications are compatible with the business processes of mainstream production builders. Builders must be able to incorporate program requirements into their practices. Energy Star is a voluntary public-private partnership, designed to work with industries to make product changes that favor the environment. The same is true for IAP, which encourages builders to reduce the risks posed by bad indoor air quality in the homes they sell through improved design and construction. This goal cannot be achieved if the largest builders do not participate. Therefore, mainstream builders are a priority market for the program, and the IAP specifications are designed to be compatible with their processes.
4. ***Verifiable.*** The IAP specifications are specific and measurable. This makes it possible for a third-party inspector to verify builder compliance before awarding the label. IAP specifications are verified primarily by home energy professionals, just like Energy Star-qualified homes are.

The Highlights

The IAP technical specifications are designed to contribute to improved IAQ in new homes, as compared to code-built homes. The highlights of these specifications are summarized below.

Moisture and mold control. Several IAP specifications are designed to control moisture and mold. These specifications are included to reduce the risk of triggering respiratory symptoms. A number of practical moisture control features can be included in house designs—features that will reduce the risk of water leaks, condensation, and mold growth. IAP includes 20 specifications (many with climate variations) for proper site drainage, envelope water management, and control of indoor relative humidity. Many of these specifications are code requirements in much of the United States. However, moisture problems persist, either because the codes are outdated or because they are not enforced.

IAP moisture control specifications start with proper foundation drainage. They include the use of drain tile; waterproof coatings; capillary breaks installed beneath concrete slabs; and grading, to ensure that exterior water drains away from the house.

Next, IAP specifies several envelope details designed to prevent the most common water problems (leaks, ice dams, condensation, and mold growth). Envelope moisture control includes:

- a continuous drainage plane, designed to shed exterior water away from the building;
- proper flashing, especially in roof-wall interfaces, penetrations, and window and door openings; and
- an extra layer of protection for roof assemblies in all but dry climates, including drip

edges, bituminous membranes at valleys and penetrations, and 30-lb roofing felt.

To prevent condensation in the wrong places, the envelope also must be designed to control the flow of warm, moist air to any cool surface. It doesn't matter whether it's winter or summer, inside or outside. The cool surface can be a surface inside a wall assembly in winter, or an air-conditioned interior wall in summer. If air leaks allow warm air to reach these cold spots, moisture in the air can condense. IAP-specified condensation control includes air sealing, to reduced the infiltration of cold winter air or warm moist summer air; and insulating properly, to control the dew points of exterior wall and roof assemblies.

Radon-resistant construction. Exposure to radon is a risk for lung cancer. IAP-specified mitigation systems have been proven to reduce home radon exposure. For new homes, cheap and easy construction techniques can be used to make the home radon resistant. Radon-resistant construction is an IAP requirement in those parts of the country where radon exposure is known to occur. IAP-specified radon resistant construction includes:

- gravel and plastic sheeting below concrete slabs;
- fully sealed and caulked foundation penetrations;
- plastic vent pipe running from below slab through the roof; and
- an attic junction box (so an electric fan can be easily added to the vent pipe if necessary).

Pest barriers. Rodent and insect droppings are both known asthma triggers. Pest barriers are a first-line defense against rodent and rat infestations, one that, if properly installed, will reduce the need for using pesticides in the future. IAP specifications designed to control pests include:

- air sealing cracks or potential cracks in the building envelope (this is already an Energy Star requirement);
- installing screens at openings that cannot be fully sealed or caulked;
- reinforcing concrete slabs with steel rods to prevent them from cracking; and
- installing a solid top layer of foundation walls in areas of the country subject to termite infestation.

HVAC system. Fresh-air ventilation, improved filtration, and effective HVAC distribution together reduce the risk of exposure to asthma and allergy triggers, and increase occupant comfort. IAP specifications designed to address these issues start with best-practice design and installation of HVAC systems. This includes:

- proper HVAC system sizing and installation;
- duct systems sized and installed to established best practice;
- no ducts or air handlers in garages, which are often highly polluted;

- no ozone-generating air cleaners;
- dehumidification in hot-humid climates;
- systems inspected for cleanliness prior to occupancy; and
- duct tightness requirements verified with leakage testing.

Ventilation systems are required to replace stale indoor air with fresh outdoor air, and to eliminate the buildup of pollutants generated indoors (such as humidity, odors, chemical emissions, and the products of combustion). IAP specified ventilation requirements include whole-house systems, designed and installed according to ASHRAE Standard 62.2 2004; and spot ventilation in kitchens and bathrooms, designed and installed according to the same standard.

Forced-air heating and cooling systems also require air filtration. IAP specifies MERV 8 or better air filters to remove airborne particulates, and the filter is installed in a rack designed to minimize filter bypass.

Combustion venting. Combustion gases from fireplaces and heating appliances can be a significant source of particulates, nitrogen oxides, and other pollutants, including CO. IAP protects residents from potential exposure to these harmful gases by specifying:

- direct-vented or power-vented equipment, if gas- or oil-fired heating systems are installed;
- fireplaces and stoves that meet minimum efficiency requirements and are properly vented;
- no unvented combustion appliances;
- attached garages fully sealed from living spaces, and equipped with a continuously operated exhaust fan; and
- a CO alarm in each sleeping area.

Low-toxicity building materials. Exposure to formaldehyde, especially, is a risk factor for cancer. IAP specifies rules for selecting building materials that typically contain formaldehyde and other potentially harmful volatile organic compounds. IAP specifications focus on two product classes with typically high concentrations of urea formaldehyde. These are carpeting, padding, and adhesives, which must meet the requirements of the Carpet and Rug Institute's CRI Green Label program; and pressed-wood materials, including plywood and medium-density fiberboard (MDF), which must meet The Engineered Wood Association (APA), American National Standards Institute (ANSI), and HUD standards for low/no urea formaldehyde content.

IAP specifications governing materials also help to control moisture and mold by protecting materials stored on-site from weather damage, and by selecting and installing materials in

such a way as to minimize the risk of moisture damage. Finally, IAP specifies that homes where installed materials are likely to emit airborne pollutants must be ventilated prior to occupancy.

Consumer education. IAP helps to ensure that homes will operate as designed by requiring that radon test kits for homes be provided in high-risk radon areas; and by providing a manual to educate owners about their new home's IAQ features.

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For more information: Details about the Energy Star IAP program are included in the IAP specification document and the verification checklist, both available for download in PDF at www.energystar.gov/homes/iap. For more information about IAQ and related health risks, visit www.epa.gov/iaq/ia-intro.html.

(Note: The views expressed in this article are those of the author, and do not necessarily represent those of The Healthy House Institute, LLC.)

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