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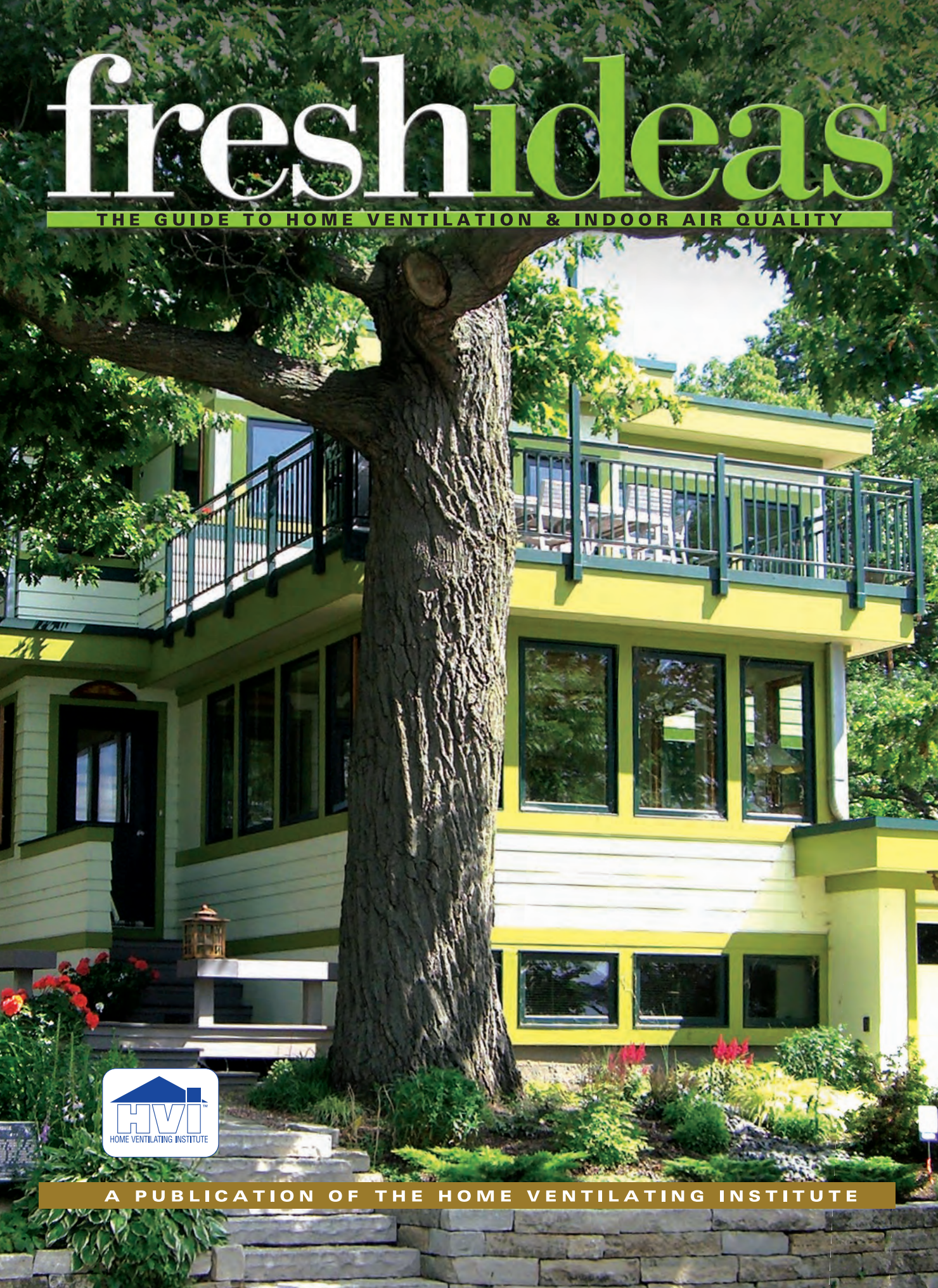
THE GUIDE TO HOME VENTILATION & INDOOR AIR QUALITY



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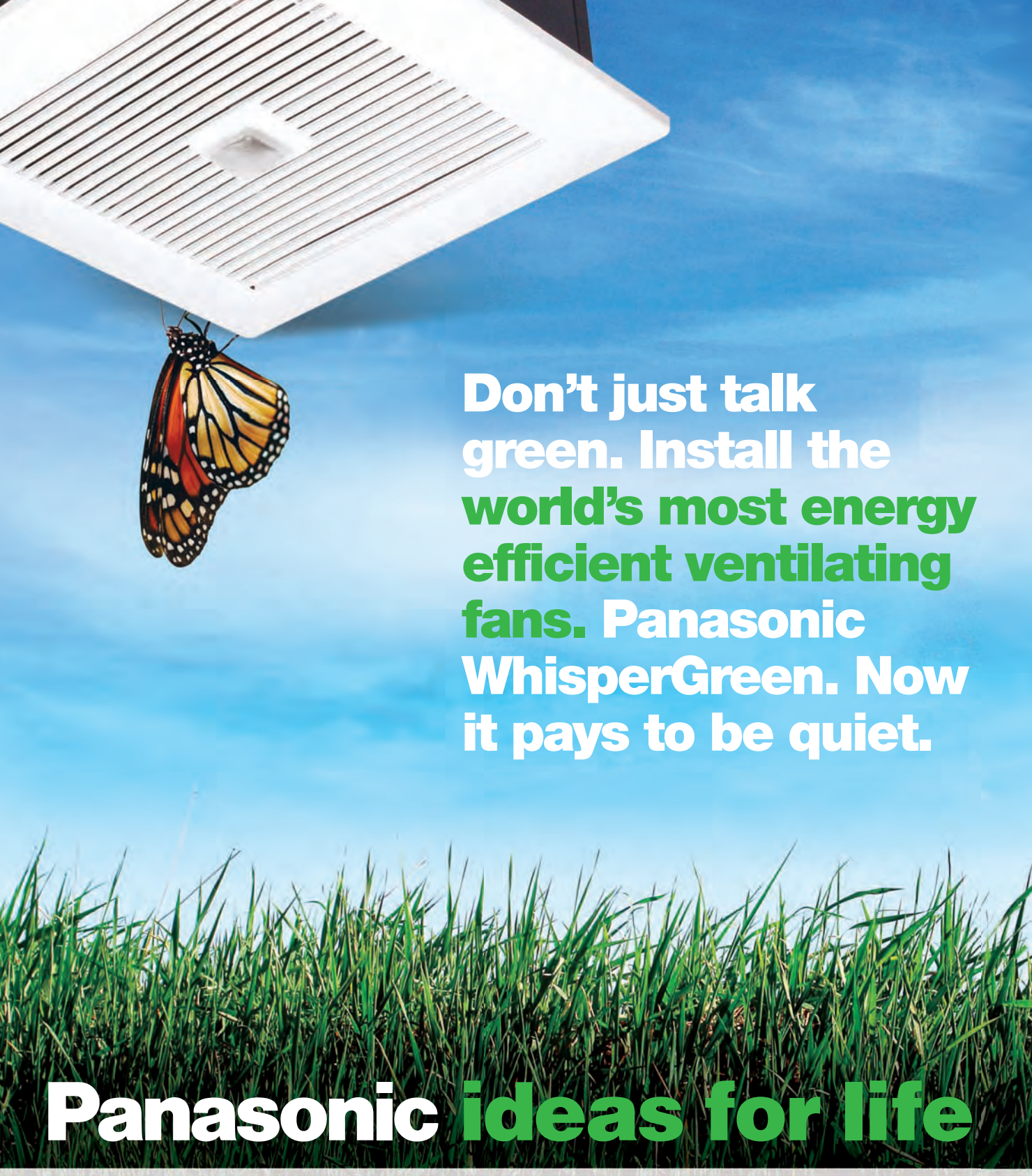

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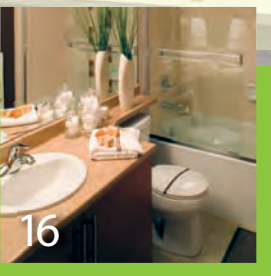

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freshideas The Home Ventilating Institute's

Guide to Home Ventilation and Indoor Air Quality

This is the Home Ventilating Institute's fifth edition of Fresh Ideas. As you read the articles, you'll notice a strong emphasis on energy efficiency, indoor air quality (IAQ), and "green" building. If you listen to the world's experts (we do), you already know that we are facing a global environmental crisis and are approaching a "tipping point" – a point of no return.

The Home Ventilating Institute (HVI) has called upon its member companies, who are responsible for the manufacture of approximately 98% of the residential ventilation products sold in North America, to step up their efforts to employ cutting-edge technology and responsible business practices to bring to the building industry the very best in energy-efficient, environmentally sound products.

We are now calling on you to step up your efforts as well. Whether you're a builder, contractor or home owner, we encourage you to be proactive in reducing the environmental impact you have on the world in which we live. There are a wide variety of mechanical ventilation options available to help you improve the quality of indoor air. Whether you are building a new home or renovating an existing one, the information in this magazine will aid you in choosing wisely those ventilation products which best suit your specific needs. The home shown on the cover of this issue of Fresh Ideas and featured in our case study, "Building a Greener Future", is a great example of homeowner ingenuity and dedication to the philosophy of sustainable building.

For our part, HVI is continuing its efforts to "advance the value of residential ventilation for healthier living" through partnerships with environmentally focused organizations such as the Healthy House Institute (HHI) (www.healthyhouseinstitute.org). HHI shares our philosophy that a house is a system made up of many interrelated parts. HHI seeks to educate consumers on such topics as air and water quality, building, remodeling and furnishing, cleaning and housekeeping, health and safety, ventilation, lighting, energy efficiency and more. HVI is proud to collaborate with HHI on its education efforts.

HVI is a key partner of the U.S. Environmental Protection Agency's (EPA) ENERGY STAR Program for Residential Ventilating Fans. Members of our association are largely responsible for the ventilation program's original development, and HVI has advocated strongly for ENERGY STAR ratings throughout the years. In order for a product to achieve the prestigious ENERGY STAR rating, it must first be HVI-Certified for performance. That's strong evidence of the value of HVI's Certified Ratings Program. Moreover, ENERGY STAR is just one of many programs, organizations and building codes that rely on HVI's independent, third-party testing and verification of residential ventilation products. A detailed list appears in our article entitled, HVI-Certified Ventilation Performance – Everyone Wins! which starts on page 6.

HVI has developed a solid reputation throughout the building industry and with consumers over the years. Today we are in a better position than ever before to expand our efforts. Since the last edition of Fresh Ideas, published December 2006, membership in HVI has increased 43 percent and the number of HVI-Certified products has increased by 17 percent. The increased value that manufacturers are placing on HVI's Certified Ratings Program is, in part, a direct result of the growing emphasis on "green" building and environmental stewardship in North America. Ventilation manufacturers recognize that they must meet consumer demands for energy-efficient products they can trust and are taking steps to ensure their products bear the respected HVI-Certified label for performance.

At the end of 2008, HVI formed a partnership with the Energy & Environmental Building Association (EEBA) to develop a half-day ventilation workshop designed to provide a better understanding of the importance of mechanical ventilation in sustainable housing. This ventilation workshop, which complements the half-day IAQ workshop introduced by EEBA in 2007, will be offered with EEBA's Houses That Work Program, which educates

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several thousand builders each year. To learn more about our Ventilation Workshop, visit www.eeba.org

HVI will be the first to tell you that there's more to energy efficiency than simply installing HVI-Certified ventilation products. Selecting appropriate products, effective system design and proper installation are key components of creating a "green" home, maximizing indoor air quality and achieving a comfortable, healthy environment for its occupants. Builders, contractors and homeowners must work collaboratively to maximize the performance capabilities of mechanical ventilation systems. In this issue, you'll find ten tips for improving indoor air quality in your home. Here's an extra one: install straight, short duct runs in your home to minimize airflow resistance and reduce pressure drops. This elemental design technique makes it possible for smaller fans to meet the desired airflow performance, reducing the purchase cost as well as saving energy throughout the life of the product.

We are proud to bring you this latest edition of Fresh Ideas and hope you'll find the information you need to select optimally efficient mechanical ventilation systems. If we can be of further assistance to you, please don't hesitate to contact HVI headquarters at hvi@hvi.org or 847/526-2010. Our staff will be pleased to assist you.

Sincerely,

Jim Boldt
Chairman of the Board

For more information, contact:

Home Ventilating Institute (HVI)
Phone: 847/526-2010
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website: www.hvi.org

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HVI-Certified Ventilation Performance: **Everyone Wins!**

The Home Ventilating Institute (HVI) represents the world's leading residential ventilation manufacturers whose products can be found in more than 98 percent of residential dwellings throughout North America. Founded in 1955, this nonprofit organization is the leading name in performance certification of residential ventilation products, providing the link between ventilation and healthy, energy-efficient homes.

Ever since five companies that manufactured ventilating products got together in the mid-1950s, concerned about the lack of a standard rating process for products, HVI has been trying to safeguard an indispensable part of our daily lives: air. You don't need a friend to tell you to "take a deep breath" to be grateful for the work of HVI.

HVI Certified Ratings are trusted and referenced by many local, state, provincial and federal entities including, but not limited to:

- Canadian National Building Code 2005
- ASHRAE Standard 62.2 2007
- 2006 Washington State Ventilation and Indoor Air Quality Code
- 2008 California Title 24 Energy Code
- Minnesota Energy Code
- Texas State Mechanical Code
- Wisconsin Energy Program
- ENERGY STAR Residential Ventilation Products Program
- ENERGY STAR Indoor Air Package
- U.S. Green Building Council LEED for Homes Program
- U.S. Department of Energy Building America Program
- National Association of Home Builders/International Code Council National Green Building Standard
- Residential Energy Services Network (RESNET) Home Rating System
- Building Performance Institute Home Rating System
- American Lung Association Health House Program
- Most green building programs
- U.S. Department of Housing and Urban Development
- National Electrical Manufacturers Association (NEMA)

HVI's mission is to "advance the value of residential ventilation for healthier living." With the ever-increasing focus on energy efficiency and comfort, it becomes increasingly important to "build tight and ventilate right." Proper mechanical ventilation is necessary to ensure a healthy environment for the occupants and to protect the building structure. HVI's Certified Ratings Program provides the means for uniform and unbiased comparison of product performance including airflow, sound and energy usage.

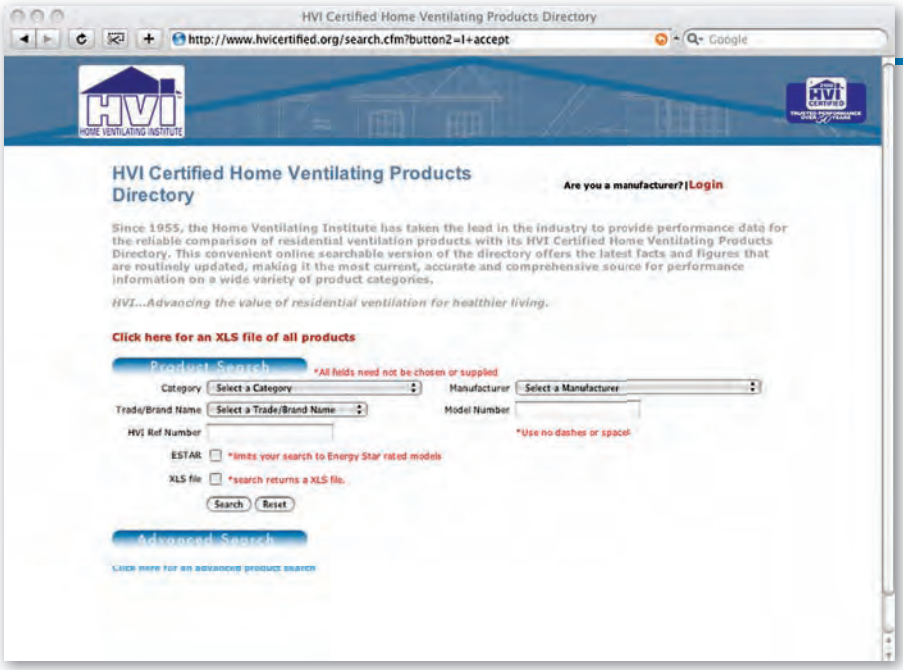
Following initial certification, products are subject to ongoing, random verification to ensure those products continue to meet performance expectations. An integral component of the program is the fact that all testing for certification and verification is performed by laboratories independent of any manufacturer, providing consumers assurance that the ratings are creditable.

HVI certification is available for a wide range of home ventilating products including:

- bathroom exhaust fans
- kitchen range hoods
- heat recovery ventilators
- energy recovery ventilators
- inline single- and multiport fans
- remote exterior mounted ventilators
- powered attic ventilators
- kitchen exhaust fans
- other room exhaust fans
- whole-house comfort ventilators
- static vents
- downdraft kitchen exhausters
- fresh air inlets
- integrated supply and exhaust ventilators

As the market evolves, so does HVI, incorporating new product categories as needed.

A complete list of HVI certified products can be found in the Certified Home Ventilating Products Directory at *www.hvicertified.org.*



Visit www.hvicertified.org for a complete list of all HVI-Certified products.

Look for these marks on products certified by HVI.

HVI's Certified Ratings Program

What does HVI's Certified Ratings Program provide you?

- Confidence that you are choosing a product that has been tested and certified to meet specific industry standards.
- A guarantee that the product will perform as promised.
- Assurance that, when installed correctly, the occupants will receive proper ventilation to maximize indoor air quality.

Who benefits?

Everyone in the residential building industry benefits from HVI-Certified ventilation performance, including:

Residential ventilation manufacturers – The HVI Certified Ratings Program provides a level playing field in a competitive market for HVI member companies, ensuring that products can be compared fairly.

Homebuilders – By specifying HVI-Certified products, homebuilders can ensure they are meeting the ventilation rates specified by building codes and limit any liabilities that may arise from improper ventilation. More state and energy conservation programs are specifying the energy consumption of ventilation products, making HVI Certification, which is used by the ENERGY STAR program, a necessity.

Mechanical contractors – Armed with HVI Certification data, contractors can select products that meet building code requirements with confidence, knowing they will provide the necessary airflow. Installers can also select products for sound and make recommendations to their builder and residential customers regarding the various options. In locales where the energy consumption of ventilation fans is mandated, HVI Certification gives contractors the information they need to make sure the requirements are met.

Consumers – Ventilation products are designed to make homes more comfortable and healthy. HVI Certification ensures consumers that those products will perform as expected.

A Key Component to "Green" Building – Ventilation

The concepts for "green" building are not new trends. The energy crisis of the early 1970s created many initiatives to improve home building practices and led to the development of a wide variety of new and improved products. It was recognized that poor insulation, air leakage and inefficient windows were responsible for most of the energy being consumed by a typical home. Over the last three decades, building science research has refined our knowledge, and manufacturers have continuously improved products, pushing green building into the mainstream where its impact can truly make a difference.

A tighter, well-insulated home saves energy, increases comfort for its occupants and creates an opportunity to manage indoor air quality (IAQ) effectively through the careful selection of materials and the proper use of mechanical ventilation. The wide variety of ventilation products available on the market today makes it possible to control airflow in every area of every home. Whether the need is to exhaust moisture from bathrooms, cooking odors from kitchens or improve overall air quality throughout the entire dwelling, quiet, energy-efficient solutions are readily available.

Houses Are Systems

A house is a system integrating the building envelope, windows, heating and cooling systems, ventilation and, most importantly, the occupants. Understanding that all the components must work together is key to successful green buildings. So important is the need for proper ventilation that all green building programs require mechanical ventilation individually designed for each house.

Bathrooms

Bathrooms in green homes must have mechanical ventilation to remove excess humidity and odors. Check for ventilation rate requirements with local authorities and specific green building programs. There are many HVI-Certified product options that can be used to meet these varied requirements.

Surface-mounted fans — Traditional surface-mounted fans are available in wide ranges of prices and performance levels. It is possible to select products today that are almost silent, use very little energy and still provide powerful ventilation. Fans approved for installation in showers and steam rooms serve to exhaust moisture very effectively. Humidity-based controls can provide automatic operation, and timers ensure that ventilation continues long enough to reduce moisture levels.

Inline fans — Inline fans are typically installed remotely, often in attics and basements, which helps keep any noise from the fan's operation at a minimum in the occupied areas of a home. One fan can be used to ventilate two or more bathrooms through a common exterior exhaust hood. A variety of exhaust grilles are available, some with lights incorporated. Inline fans are a good choice when the duct runs to the outside of the home are long, as they are better able to maintain airflow.

Integrated controls — Integrated controls for exhaust fans have recently been introduced that allow several separate fans to operate as a system to meet both intermittent and continuous ventilation requirements. These "smart" systems sense the need for ventilation and can be programmed to fit the house in which they are installed to optimize air exchange while minimizing energy loss.

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Heat and energy recovery ventilators — Heat and energy recovery ventilators (HRVs/ERVs) can also provide ventilation for bathrooms. Transfer of energy from one air stream to the other allows HRVs and ERVs to minimize energy consumption while providing quiet ventilation through ductwork connected to bathrooms and kitchens. Controls installed in a bathroom allow the continuous ventilation rate to be increased when needed to remove excess moisture and odors. The combination of continuous and intermittent ventilation ensures that bathrooms remain dry and fresh.

Kitchens

All kitchens produce moisture, odors and smoke, making good ventilation essential in every home. Although the intermittent ventilation needs associated with cooking are the most obvious, kitchens also need continuous ventilation to maintain indoor air quality at all times.

Range hoods — A kitchen range hood is a fan with an enclosure designed to capture and exhaust the heat, odors, gases, grease, steam and smoke produced by cooking. A range hood's fan effectively captures the rising column of air directly over the cooking surface and then exhausts the contaminants outside the home.

Recently, HVI-Certified range hoods bearing the ENERGY STAR label were introduced into the marketplace. The ENERGY STAR label indicates that products meet strict energy efficiency guidelines set by the U.S. Environmental Protection Agency (EPA) and the Department of Energy (DOE). ENERGY STAR-qualified ventilation products that include lighting use 70 percent less energy, on average, than standard models equipped with halogen lights.

Bedrooms

We spend six to ten hours of each day in our bedrooms – they need fresh air, and opening windows is not always the best option. Distribution of fresh air to bedrooms is a requirement of most green housing programs and can be accomplished with exhaust and supply fans, heat and energy recovery ventilators, or distribution through the forced-air heating system.

Other rooms

Other rooms of the house may require local ventilation to address periodic high levels of contaminants resulting from various hobbies or temporarily increased level of activity of the home's occupants. Local ventilation exhausts pollutants before they spread throughout the home, which is important to any homeowner who wants control over indoor air quality.

Garage

Attached garages are obvious sources of pollution — from unhealthy odors from cars, garden chemicals and other stored items to deadly carbon monoxide. In today's advanced green homes, the shared walls between the living area and garage are carefully sealed to minimize the entry of contaminants through infiltration. However, when the entry

door between the garage and house is open, there is a risk that contaminants may enter. An exhaust fan activated by garage door activity will help ensure that the extra load of pollutants generated when a car enters or leaves does not enter the home. Air should continue to be exhausted for at least 20 minutes after a car has entered or left the garage to ensure that exhaust fumes are sufficiently diluted. Any combustion heating systems that are not completely sealed need to be supplied with make-up air to ensure safe operation.

Why Build Green Homes?

There are clearly significant benefits to applying proven mechanical ventilation techniques when building new or renovating homes to green building standards:

- Reduced operating cost for the entire lifespan of the home, which is often much longer than anticipated.
- Increased comfort and control of the indoor air, allowing occupants to lower the risk of certain illnesses and maintain improved overall health.
- Reduced maintenance and repair as a result of tight construction on the inside and exteriors that are designed to stay dry.
- Increased resale value as a result of all the above benefits.

Ventilation is a critical component of green homes, and today the HVI-Certified product choices to meet the requirements of advanced building programs and satisfy customers have never been better.

Indoor Air Quality – Room to Improve

North Americans spend as much as 90 percent of their time indoors. Whether at home, work or play, our time is increasingly spent inside buildings. And we always need air to breathe, so we should make every effort to protect the quality of that air. On any given day, we each consume more air than we do water or food, both of which are highly regulated for safety. As a society, we spend large sums of money to guarantee that our food and water supplies meet rigorous quality standards. Regulating the quality of our indoor air may be more challenging, but it is clear that there is a direct correlation between ventilation and indoor air quality (IAQ). Decades of study of IAQ have led to the development of industry-recognized ventilation rates, which are intended to maintain reasonable air quality.

Health Consequences

The U.S. Environmental Protection Agency (EPA) has determined that indoor pollutants can be two to five times higher than outside air. Poor air quality contributes to asthma, respiratory infections, allergic reactions, headaches, eye and skin irritations, fatigue, dizziness and nausea. Studies suggest that a person's ability to perform mental tasks requiring concentration, calculation or memory can be negatively impacted by air quality deficiencies.

Some health issues may be evident following limited exposure to "bad air". Other health impacts may only appear after long and repeated exposure to contaminants, which is even more reason to make certain that the best possible indoor air quality is provided and maintained.

In addition, uncontrolled indoor moisture levels can result in mold growth and damage to finishes and structures. Mold is a significant problem in housing, and good ventilation is one of the solutions to ensure that the damp conditions necessary for growth are controlled.

Sources of Pollution and Control

Our homes are often finished with materials containing a wide variety and complexity of chemicals. Paint, cabinets and floor coverings all can contain chemicals that contribute to poor indoor air quality. And we fill our homes with furnishings, electronic equipment, cosmetics and cleaning products that add to the contamination of the air we breathe. It has become a common but ill-advised practice to use plug-in air fresheners and other odor-masking sprays to temporarily hide unpleasant odors, which only adds more chemicals to the living environment.

So what can we do to remedy the problems associated with poor indoor air quality? First, we can exercise care when we select the materials used to finish the interiors of our homes. Today, homeowners can select paint, floor coverings, cabinets and all other finishing materials that have very low levels of volatile chemicals. It is somewhat more difficult to control the furnishings and electronics, but we can minimize the use of cleaning products and select those that are more environmentally friendly. And good ventilation practice can replace the need for chemical-based air fresheners.

Ventilation – Natural Is Not Enough

Ventilation – simply exhausting stale indoor air and replacing it with fresh outside air – is the best way to ensure continuous indoor air quality. However, sufficient exchange of air without mechanical assistance is just not possible. Older homes

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Ten Tips for Good Indoor Air Quality

To avoid common air quality problems within the home, follow a few simple steps:

1. **Select HVI-Certified ventilation products** for your home to ensure airflow, sound and energy performance expectations are met or exceeded.
2. **Operate the bathroom exhaust fan when bathing** and showering to limit moisture buildup. Operate your fan for 10 to 60 minutes after you finish your bath or shower to remove most of the moisture in the room.
3. **Turn on range hood fans when cooking** to expel moisture, odors and contaminants released while cooking.
4. **Increase ventilation rates during family gatherings** and parties. Use of intermittent or "spot" ventilation will help keep the air fresh, even during periods of increased activity in the home.
5. **Ensure that continuous ventilation is provided** in addition to the intermittent ventilation systems. The entire house needs continuous ventilation to see that general air quality is maintained in all areas.
6. **Ensure that clothes dryers are exhausted directly to** the outside, and make sure that filters and hoods are cleaned regularly to maintain maximum airflow.
7. **Plan routine seasonal maintenance** for heating, ventilating and air-conditioning (HVAC) equipment to ensure all systems are working properly and performing as intended.
8. **Change filters as instructed.** Inspect, clean or replace furnace and ventilation system filters according to manufacturers' recommendations. Consider installing high-efficiency particulate filters for better performance.
9. **Clean your home regularly** to prevent dust, dirt and pet hair accumulation. Dust and dirt particles can become airborne, adding to the contaminants in the air.
10. **Use products that emit the lowest levels** of chemicals. Many cleaning products can release toxic or irritating chemicals when used. New or recently installed building materials and furnishings can also emit significant harmful contaminants.

certainly have more air leakage than those built in recent years, but the problem is that those leaks do not guarantee that stale air will be replaced by fresh air. In new homes, air leakage is minimized through the use of improved building practices, more efficient windows and air tightness testing. The benefits are lower heating and cooling costs and the opportunity to apply mechanical ventilation to give homeowners control over their environment.

Intermittent Ventilation

Bathrooms need mechanical ventilation to exhaust moisture from bathing and odors. Moisture not properly managed can create conditions for mold to grow, creating health concerns and damaging expensive-to-repair finishes. It is best to exhaust moisture directly from showers. HVI-Certified ventilation products rated for installation in showers are readily available.

Kitchens also require mechanical ventilation to address the odors and moisture created from cooking. A properly sized and ducted range hood located over the cook top will ensure that contaminants are exhausted directly to the outside. Very large capacity range hoods actually need outside air to be supplied to compensate for the air being exhausted. Make-up air systems linking the operation of the hood to an inlet device are necessary to ensure that the house is not depressurized. Depressurization is alleged to cause backdrafting of combustion appliances such as furnaces, boilers and hot water tanks. More information on selecting range hoods can be found on the HVI website.

Additional rooms used for crafts or hobbies that produce air contaminants need to be separately ventilated to ensure that the contaminants do not mix with the general house air.

Continuous Ventilation

While some specific areas of the home need local, intermittent ventilation to manage obvious IAQ issues, the entire house needs continuous ventilation to see that general air quality is maintained in

all areas. There are several strategies that can be used to meet this need.

Surface-mounted fans that are designed for quiet, continuous operation can be installed in a central area of the home to meet the ventilation requirements stipulated by the local building authorities. Some ventilation systems now utilize "smart" technology, linking separate fans to address both intermittent and continuous needs.

Heat and energy recovery ventilation systems have the added benefit of saving energy and distribution of tempered fresh air to bedrooms and other living areas. In some cases, HRVs and ERVs can be used to provide both continuous and intermittent ventilation using switches in bathrooms that increase the ventilation rate for short periods of time.

HVI-Certified Ventilation Performance

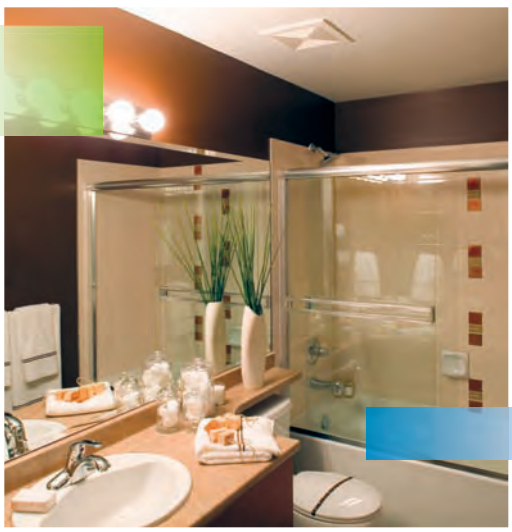
All homes can benefit from mechanical ventilation – the first choice for indoor air quality control. And the first thing to look for when selecting any residential ventilation equipment is the HVI-Certified label. The HVI-Certified label is your assurance that the product has been independently tested for airflow, sound and energy performance. To verify that the certified performance is maintained, the products are independently retested according to a regular schedule by HVI.

Indoor air quality control through mechanical ventilation is a key component of all residential dwellings and a necessity for those built to green building standards.

Ventilation – The Solution to Indoor Air Quality

What makes the air in a home comfortable, healthy and sustainable? The answer is mechanical ventilation. Good ventilation systems will exhaust stale air to the outdoors and systematically introduce fresh air into the home, diluting pollution levels. Ventilation can moderate extremes in indoor humidity. A lower humidity level reduces mold and other biological growths to enhance occupant health, and contributes to a more durable home.

Studies have shown that, in most cases, outdoor air is much cleaner than indoor air whether a home is located in an urban or rural setting. In fact, the U.S. Environmental Protection Agency (EPA) has found indoor air to be two to fives times more contaminated than outdoor air. This is because a home's interior accumulates and concentrates pollutants given off by finishes, furnishings and the daily activities of the occupants. Today's homes are "tighter" (less drafty) and generate lower fuel bills than their predecessors, but as a side effect, the indoor air quality (IAQ) can suffer without adequate mechanical ventilation.



What's the Difference?

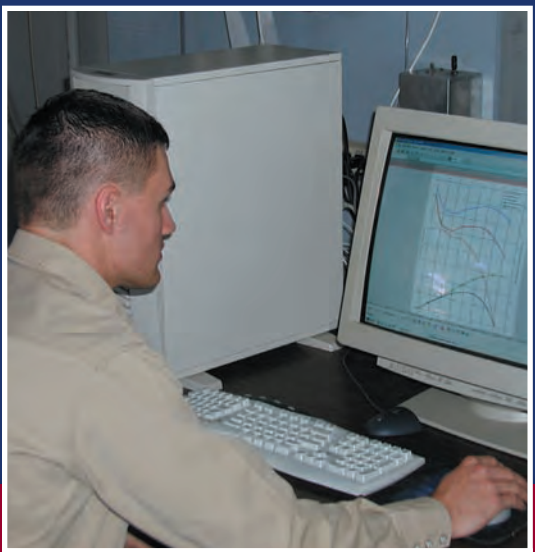
Whole-House Fans, Whole-House Comfort Ventilators, Whole-House Ventilation Systems?

These terms are used somewhat interchangeably, which has caused a great deal of confusion to consumers as well as industry professionals. To clarify, we are providing the following distinctions between the terms:

Whole-house fan is the term properly used for the big fan that sits in the center of the top floor ceiling, between the house and the attic. It generally has louvers in the ceiling that are opened by the rush of air flow through the fan. The fan vents into the attic, pressurizing the attic and hopefully pushing the air out through the attic vents properly sized for the particular whole-house fan being installed. The purpose of the whole-house fan is to accelerate the natural cooling effect of bringing cooler outside air into the house through open windows and venting it out at the top of the house or the top of the "stack."

Whole-house comfort ventilator is the term coined by the Home Ventilating Institute (HVI) to try to differentiate the whole-house fan from a whole-house ventilation system. A whole-house comfort ventilator is HVI's term for a whole-house fan – they both essentially refer to the same product. The purpose of the whole-house comfort ventilator term was to distinguish a whole-house fan as a cooling product without implying that it is an air-conditioning system. Whole-house comfort ventilators and whole-house fans have no mechanical cooling element but rely on a natural temperature difference between the inside and outside of the home.

Whole-house ventilation system is a relatively new term for a mechanical system to move air through a house continuously at a relatively low flow rate. The purpose of a whole-house ventilation system is to provide a continuous air change for fresh air to maintain healthy living conditions for the occupants and the building itself, not to cool the temperature of the living space. So the purpose of a whole-house ventilation system is very different from the purpose of a whole-house fan or whole-house comfort ventilator.



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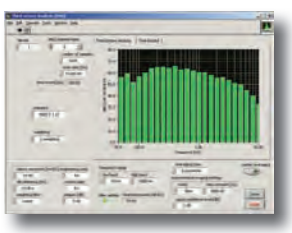

Sound Spectrum Analyzer

For more information:
- Kelly Milligan, 979-845-6404, fantesting@esl.tamu.edu

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The need for mechanical ventilation is widely recognized by building scientists, health authorities and building code officials. This is why federal, state/provincial and local building codes throughout North America require ventilation systems in new home construction. While elimination of sources of pollutants is always the first step to achieving acceptable indoor air quality, ample mechanical ventilation will ensure that unanticipated or new chemicals that may be introduced will also be controlled.

There are a wide variety of products sold specifically as indoor air quality solutions for the home. Some examples include filters, air purifiers, ultraviolet (UV) or germicidal lighting, humidifiers, dehumidifiers and a variety of air quality monitoring devices. The effectiveness of these devices varies greatly. Certainly some people may benefit from the use of a specific technology, but others may experience no benefit. And some available technologies may actually adversely affect users. It's important to note that none of these technologies eliminate the need for proper mechanical ventilation, which is best achieved through the installation and use of the HVI-Certified products listed at the end of this article.

Filtration

Filtration is the physical removal of particles from the air. Individuals with seasonal allergies to pollens can benefit from filtration. Long-term health may be impacted by inhalation of very small atmospheric dust that requires special filters or electrostatic deposition. The source of most indoor dust is actually the activity of a home's occupants, and local or central filters are not able to significantly control dust that is stirred up by occupants walking through a room, making a bed or using a towel. A filter located in the furnace circulation system sees only a small percentage of the total air volume in a home at any one time. By the time all the air and dust can be moved through the filter, a home's occupants have been exposed to the billions of particles stirred up by the ongoing activities. Mechanical ventilation reduces particulates and controls the gases, odors and humidity that filtration does not.

Air Purifiers

Air purifiers claim to deal with odors and gases through absorption, ionization, ozone generation or catalytic processes. These devices have success in specific industrial applications but can cost a lot to operate. Residential products are typically low-powered, which means that there is limited practical benefit in the home. Some of these products actually produce ozone, which can be a health risk at elevated concentrations. Modest amounts of mechanical ventilation can effectively expel gaseous pollutants from the home instead of using more complex air-purifying systems that must absorb or convert these pollutants in place.

UV Lights

Ultraviolet or germicidal lights kill germs and other organisms by exposure to sufficiently high levels of ultraviolet light. High-power lights are required, which can result in high operating costs for energy and lamp replacement. UV lights have no impact on particles, gases or odors. Mechanical ventilation can provide the same benefits as UV or germicidal lights by controlling excessive humidity levels, ensuring that bio-organisms do not have a favorable environment for growth.

Humidifiers and Dehumidifiers

Humidifiers and dehumidifiers add or take away humidity for comfort, and control of biological growth in the home. Seldom should humidity be added to any properly designed and ventilated home. Dehumidifiers may be necessary if excessive moisture levels persist and cannot be controlled through

ventilation or air conditioning. Dehumidifiers use significant energy and cannot control particulates, gases and odors. Mechanical ventilation exhausts humidity without a costly refrigeration system.

Air Quality Monitors

There are hundreds, if not thousands, of chemicals that could be a concern in the home. To attempt to monitor each of them would be extremely expensive and require regular calibration to maintain effectiveness. At best, air quality monitors simply provide a description of the problem; they do not solve it. Consequently, ample mechanical ventilation is simply the best solution. It will reduce pollution concentration, no matter what pollutants happen to be present.

It's clear that there is no substitute for mechanical ventilation. Properly designed and installed, mechanical ventilation systems will provide adequate control of indoor air quality without the need for any additional products that are likely to be of limited use and questionable effectiveness.

The Home Ventilating Institute (HVI) recommends the installation and use of ventilation products such as:

> bathroom exhaust fans
> kitchen exhaust fans
> other room exhaust fans
> kitchen range hoods
> heat and energy recovery ventilators
> whole-house comfort ventilators
> downdraft kitchen exhausters
> inline fans
> powered attic ventilators
> remote exterior mounted ventilators
> integrated supply and exhaust ventilators
> static vents

Remember, to ensure that ventilation systems will perform as required, select only products which are HVI-Certified.

Ventilation – Myths & Facts

- **Myth:** Mechanical ventilation is not necessary as long as you open up windows.
- **Fact:** Operable windows have many shortcomings as an effective ventilation solution in the home. Homeowners cannot set a specific ventilation rate due to constantly changing conditions such as wind speed and direction, temperature differences between indoors and outdoors, operation of heating and air-conditioning systems, and many other factors. Comfort can be significantly compromised in certain climate zones. Open windows are also a source of dust, pollen, noise as well as a security risk.

- **Myth:** You can always trust a manufacturer's marketing literature as a gauge for how a product will perform.
- **Fact:** Performance claims for ventilation products that have not been independently tested and certified are questionable. If the product is not HVI-Certified, homeowners have no assurance that the ratings have not been inflated or that the product will perform as indicated.

- **Myth:** Mechanical ventilation will eliminate all indoor air pollutants.
- **Fact:** Mechanical ventilation is an important part of indoor air quality (IAQ). Beyond the control capabilities of ventilation products, homeowners should also strive to limit the sources of pollutants introduced into the home through chemical-based cleaning products, certain furnishings and finishes.

- **Myth:** More powerful fans result in higher operating costs.
- **Fact:** While this used to be the case, ventilation products are now available that utilize highly efficient motors, allowing even powerful fans to operate quite cost effectively.

- **Myth:** Fans need to be loud in order to be powerful.
- **Fact:** Advances in fan design have reduced fan noise significantly, allowing fans to be strong as well as nearly silent. Look for products with HVI-Certified sound ratings of 1.0 sones or less for very quiet ventilation.

- **Myth:** A fan's installation has no bearing on its performance.
- **Fact:** Improper installation can make even the best ventilation product perform poorly. To ensure optimal performance, follow the manufacturer's instructions and install duct runs which are as short and straight as possible with tightly sealed connections.

Innovative Ventilation Products

Innovations in ventilation products have increased steadily as our understanding of building science has accelerated in the last three decades. To save on energy costs, homes today are built much more tightly with better windows, more insulation and careful sealing of air leaks throughout the building envelope. This has created the opportunity for the ventilation industry to develop new, innovative products and systems to provide the enhanced indoor air quality possible in an advanced, green home.

Precise Control Technology

Programmable Controls

Microprocessor-based controls can balance ventilation with energy conservation as they can be programmed to operate the ventilation system as required. A multispeed exhaust fan can be operated at a continuous low speed to provide general ventilation and then boosted to high speed for a preselected time when local exhaust is desired, after a shower, as an example.

Recently introduced digital controls designed for heat and energy recovery ventilators enhance operation. Up to five speeds and four operating modes, including variable-timed operation, provide the homeowner with all the options to meet changing needs. A humidity sensor adjusts the ventilation rates with reference to outdoor temperature as well as indoor needs, providing year-round control without adjustment. Whether unoccupied, normally occupied or filled with activity during the holidays, the system can be adjusted to suit the occasion.

Integrated Ventilation Controls

Ventilation fans that once worked independently now can work together using integrated ventilation controls. Sensors are connected to ventilation devices normally located throughout the house, such as range hoods and bathroom exhaust fans. These fans are then able to communicate wirelessly with a central control, which monitors their independent operation and determines if the overall ventilation needs of the home are being met. If not, the central control will operate fans to meet the total ventilation requirements. Because these fans ventilate from different locations, fresh air is more evenly distributed throughout the home.

The system is programmed based on the size of the home and the number of bedrooms. Integrated controls allow once-independent ventilation appliances to provide many of the benefits of a whole-house ventilation system.

Occupant-Sensing Ventilation

Occupant-sensing systems utilize humidity and motion sensors to control ventilation rates based on the homeowner's activities. When a room is

occupied or the humidity levels increase, airflow rates are increased to clear the air. In one system, carbon dioxide is monitored to ensure the proper amount of fresh air is introduced to the living space to regulate indoor air quality.

More Efficient Ventilation

ENERGY STAR Range Hoods

Recently, the first HVI-Certified range hoods meeting the energy efficient guidelines of the ENERGY STAR program have been introduced.

Utilizing highly energy-efficient motors and compact fluorescent lighting, these range hoods meet all requirements of the three major green-building programs: ENERGY STAR for Homes, Leadership in Energy and Environmental Design (LEED) for Homes, and the National Association of Home Builders (NAHB) Model Green Home Building Guidelines.

Fan Motor Efficiency

New and improved fan motors are also providing opportunities for energy savings. Electrically commuted motors (EC) with integrated controls have been shown to be significantly more efficient than the permanent split capacitor motors presently used in most residential applications. The efficiency improvement is most significant for continuous fan operation at lower airflow rates.

EC motors have been shown to reduce electricity consumption up to 75 percent for continuously operating ventilation systems providing savings in operating cost and greenhouse gas emissions. These high-efficiency motors can now be found on a wide range of ventilation products from bathroom fans to heat and energy recovery ventilators.

New Designs for Small Spaces

Apartment-Sized Energy Recovery Ventilator

A recently introduced energy recovery ventilator (ERV) installs in the ceiling of a room, providing balanced exhaust and supply ventilation to ensure indoor air quality is optimized.

This new spot ERV has two ducts to connect the exhaust and supply air to the outside, while the inside air is managed through a grille that separates exhaust and supply air streams. The patented energy recovery core transfers heat and moisture to ensure that indoor comfort is maintained all year-round.

Continuously rising energy costs and increasing concerns for the environment are creating consumer demand for more efficient homes providing greater comfort and security for the future. HVI members will continue to lead the residential ventilation industry to meet the needs of the growing sustainable building industry.

Building a Greener Futur

These days, it seems that virtually everyone is promoting his or her products and business practices as "green." While the intent is positive, not all that is said to be green actually makes a positive environmental difference. Building better homes truly makes sense, and the move toward green building is surely worth pursuing. After all, our homes consume up to one-third of the energy needed to keep North America running, so reducing the energy homes use could have a significant positive impact on our environment. Today we have the knowledge, processes and products available to build homes that use a fraction of the energy previously required — implementation is relatively simple. A greater challenge we face is retrofitting our existing housing stock to counteract the excessive amounts of energy being spent.

To illustrate how existing homes can be transformed from energy guzzlers to models of efficiency, we searched throughout North America and found an excellent example in Doug Steege and Kris Euclide's house located in Madison, Wisconsin.

Originally built in 1922, the residence was completely renovated inside and out in 2006 utilizing readily available materials and products. The result is a very comfortable dwelling where Doug and Kris enjoy much lower energy bills and excellent indoor air quality.

The foundation and wall insulation were upgraded and a R100 insulation level was achieved in the attic. Old, leaky windows were replaced with triple-glazed, "Low E", argon-filled units carefully sealed into the building envelope. With the help of air infiltration experts, the entire home was examined for air leakage. Once the air leaks had been sealed, the final air test showed that the air infiltration had been reduced to less than half that of a typical Wisconsin home.

Reducing air leakage, or making the house "tighter," led the homeowners to design and implement a mechanical ventilation system to control indoor air quality, taking full advantage of the latest ventilation solutions available in the marketplace. Two HVI-Certified energy recovery ventilators (ERV) were installed to ensure that the entire home had the ventilation control to meet not only building code requirements, but also the specific needs of its occupants. An ERV is an excellent choice for a green building as it saves energy year-round. By bringing the exhaust and supply airstreams into close contact in the ERV core, energy is exchanged from one air stream to the other without actually mixing with each other. In the winter, the warmer inside air gives up energy to the cooler outside fresh air bringing it closer to room temperature. In the summer when air conditioning is keeping the house cooler, the cool air being exhausted helps to reduce the temperature of the incoming air. This reduces the load on the air

R Value

R value is a measurement used to indicate the resistance to the flow of heat from one area to another – e.g., a value of R0 would indicate that there was no resistance to heat energy while a value of R100 would indicate that the resistance was very high – a typical new home in the Chicago area likely has walls that have R12 to R20 insulation.

e

Low E

In a general sense, the term "Low E" indicates superior windows designed to manage energy and sunlight effectively. The "E" stands for emissivity which is the ability of the glass to emit or admit heat. A Low E coating is used to improve the performance of the glass by trapping radiant energy that would normally be lost from inside while blocking energy from outside to limit the heat gain during warmer weather. There are a variety of Low E coatings used depending on the direction the window will face and whether or not solar gain is desired.

-conditioning system. The ERV core also transfers water vapor, helping to maintain healthy, comfortable indoor humidity levels in all seasons.

One ERV, installed in the second-floor master bedroom closet, exhausts air from two upstairs bathrooms while supplying fresh air to the bedrooms on that level of the house. A second ERV, installed in a mechanical room located in the lower level of the home, exhausts air from the main floor bathroom and kitchen area, supplying fresh air to the family room.

These ERVs provide both continuous and intermittent ventilation. Continuous ventilation is required by code and is designed to maintain general air quality. The low rate of continuous operation offers around-the-clock protection for the occupants from the harmful effects of various odors, chemicals from furnishings and cleaning products while effectively controlling moisture. Intermittent, high-speed "spot" ventilation of the bathrooms is initiated by push-button switches, operating for a preset but adjustable amount of time. This higher rate of ventilation helps to eliminate immediate odors and moisture from showers while the lower, continuous rate ensures that showers dry effectively to reduce the potential for mold and mildew to form.

In addition to the ERVs, a range hood installed over the cook top in the kitchen provides intermittent spot ventilation during cooking. As all range hoods should, this HVI-Certified unit vents directly to the outside. An excellent choice for a green retrofit, the hood, which is ENERGY STAR-rated, uses less energy for both ventilation and lighting.

Attending to the home's heating system, Doug and Kris installed a high-efficiency sealed combustion boiler, eliminating the problems associated with open combustion air supplies into mechanical rooms. An active solar domestic hot water system completed the mechanical systems for this exceptional renovation.

Building green means more than just energy conservation, as Doug and Kris know. Low-flush toilets and low-flow faucets and showerheads reduce water consumption for the couple. Carpeting with a high-recycled material content is in use throughout the home. Low volatile organic compounds (VOCs) paint, sealants and caulking help to reduce the levels of harmful contaminants in the home. Compact fluorescent bulbs installed in all fixtures produce significant energy and cost savings. Even the landscape was designed to be drought-tolerant and low-maintenance.

To complete the green theme of this renovation, green energy is purchased from a local provider. Electricity is sourced from wind farms, solar systems and methane gas turbines. Though Doug and Kris

Natural sunlight brightens up the Lake Room.

pay a premium of one cent per kilowatt hour, this is a perfect choice for a green home. And the additional funding generated helps the utility provider to limit the development of coal-fired power plants and encourage the development of alternative and renewable energy sources. It is expected that the premium will decrease as technology advances and more renewable energy sources are developed. In fact, a utility company in Texas has been able to reduce the cost of their green energy below that of energy from conventional sources.

Doug's and Kris's home uses less energy than 95 percent of the homes in the Madison, Wisconsin, area. Doug estimates that the ERVs alone are reducing the energy costs by up to 200 dollars per year.

This is not the couple's first advanced home. Our featured home is the sixth new or remodeled home with which they've "gone green" including one of the first active solar homes in Wisconsin in 1976. The significant energy investments they have made in each of their homes have never cost them a penny. The energy savings have always been much larger than the cost of the additional loan payments, resulting in positive cash flow from the very beginning. And to make the financial picture even more enticing, more than 100 percent of the added costs have been recovered at the time of selling.

Where to Start

Green building represents a wonderful opportunity to improve the energy and resource effectiveness of our homes while providing health and comfort benefits never before possible. If you're interested in retrofitting your own energy-guzzling home, Doug and Kris offer the following tips based on their experience:

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Look for contractors who are knowledgeable in green building practices and who are familiar with Leadership in Environment and Energy Design (LEED), the National Association of Home Builders (NAHB) residential sustainability program, as well as the U.S. EPA ENERGY STAR for Homes program. Check potential contractors' references and view their past projects to ensure that their knowledge translates into effective green building practices.

Always consider energy and water in any remodeling project. Installing better insulation and reducing air leakage is an inexpensive first choice. Triple-glazed windows now cost little more than double-glazed and not only reduce energy consumption but also block outside noise much more effectively. Additionally, high-efficiency heating systems are readily available and reliable, and will save energy for years to come.

Perhaps most importantly, don't forget to consider the indoor air quality. All homes need mechanical ventilation, and retrofitting homes to be green provides an excellent opportunity to integrate the most advanced energy-efficient ventilation products available today. When selecting ventilation equipment, choose only those products which are HVI-Certified. This provides the assurance that actual airflow, sound and energy performance will meet the manufacturers' ratings when the products are properly installed and ducted. HVI has been the premier source for reliable performance data on residential ventilation products since 1955 and today lists over 2,000 products in its online Certified Products Directory available at *www.hvicertified.org.*

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Ventilation Codes & Standards

For the United States

ASHRAE 62.2-2007 Ventilation and Acceptable Indoor Air Quality in Low-Rise Residential Buildings is the U.S. national minimum ventilation standard. It is a "consensus" document developed by the American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE). It applies to all single-family houses and multifamily dwellings three stories or fewer in height. The latest version was published in 2007 and is the basis for virtually all of the ventilation requirements of the U.S. green building programs. The U.S. International Building Codes still use the higher ventilation requirements from the 1989 version of ASHRAE 62, but several states have adopted 62.2 or are considering it.

Fundamentally, ASHRAE 62.2 requires low-level, continuous ventilation in a home using a whole-building fan or other ventilation system. Intermittent whole-building ventilation can be used as an alternative, but the rates need to be considerably higher. This is primarily because the contents of a home release a wide variety of chemicals into the air continuously, whether the home is occupied or unoccupied. Those gases build up if the ventilation system is not running continuously. Also, since this is a national standard, it has been written to apply to all homes under all conditions. There are a few exceptions for very temperate climates. Providing continuous, low-level ventilation is the most effective solution in almost every case. The standard does allow for other design approaches if they have been approved by a "licensed design professional."

Note that the standard uses the term "whole-building ventilation" fan, not to be confused with the terms "whole-house fan" or "whole-house comfort ventilator." The latter are terms used to describe a very large fan used to quickly cool a house with lots of outdoor air, typically at night.

In a whole-building ventilation system, the stale indoor air must be exhausted directly to the outside. Dumping exhaust air into an attic or other internal space can have dire consequences when warm, humid air hits a surface cold enough that condensation forms, increasing the likelihood that mold growth and structural damage may occur.

Continuous ventilation rates for whole-building ventilation can be determined from Table 4.1a in the standard, shown below, or by calculation. The table determines ventilation rates based on the floor area and the number of bedrooms. Rates range from 30 cfm for a one-bedroom, 1,500-square-foot home to 165 cfm for a home larger than 7,500 square feet with seven or more bedrooms.

Floor Area (ft^2)	# of Bedrooms				
	0–1	2–3	4–5	6–7	>7
<1,500	30	45	60	75	90
1,501–3,000	45	60	75	90	105
3,001–4,500	60	75	90	105	120
4,501–6,000	75	90	105	120	135
6,001–7,500	90	105	120	135	150
>7,500	105	120	135	150	165

Table 4.1a of ASHRAE 62.2-2007.

To calculate the required flow, count 1 cfm per 100 square feet of floor area to account for the building. Next, to account for the occupants, multiply the number of bedrooms plus one (which assumes two occupants in the master bedroom) by 7.5 cfm. Then add those results together. For example, a 1,500-square-foot house with three bedrooms would require 45 cfm (15 cfm for the building plus 30 cfm for the four occupants).

The standard allows a wide variety of ventilation systems to be used from supply or exhaust fans to heat recovery ventilators (HRV) or energy recovery ventilators (ERV). Standard bath fans can be used to meet the continuous requirements if they move the required amount of air and are quiet – 1.0 sones or less based on HVI-Certified performance data.

Additionally, bathroom fans should be able to operate at 50 cfm intermittently or 20 cfm continuously. A kitchen fan should be able to move 100 cfm intermittently or provide 5 air changes per hour continuously based on the volume of the kitchen. When used to meet the intermittent

ventilation requirements, both kitchen range hoods and bathroom fans must be HVI-Certified at no more than 3.0 sones.

The standard contains numerous other requirements such as transfer of air between rooms, combustion air supply, sealing of attached garages, air filtration and other indoor air quality considerations. HVI recommends you become familiar with this important standard. A read-only version is available at *http://openpub.realread.com/rrserver/browser?title=/ASHRAE_1/ashrae_62_2_2007_1280.*

When considering the ventilation requirements for any home, it is important to remember that ASHRAE 62.2 outlines the minimum ventilation requirements. While the minimum rate may be enough to meet basic needs, it does not provide for homes with additional occupants, active children, pets and the needs of those with impaired respiratory health. HVI recommends that in addition to the minimum ventilation requirements, the continuous ventilation system should have at least 100 percent additional capacity to allow the occupants to select the fresh-air delivery rate that best suits their needs.

For Canada

The most recent version of the National Building Code (NBC) is the 2005 edition, and although there are some provincial variations, the ventilation provisions (Section 9.32 of the NBC) are being consistently applied across the country. The 2005 NBC ventilation requirements have many similarities to the Ontario Building Code requirements that were adopted as early as 1993. The following information will be useful to HVAC contractors, builders, building officials

and homeowners to interpret and implement the NBC 2005 requirements.

In all cases, qualified designers can choose to design ventilation systems using the *Canadian Standards Authority (CSA) F326 Residential Mechanical Ventilation Standard.* The Section 9 requirements were designed to be consistent with CSA F326 but are effectively a simplified, prescriptive version of it. Designers have more flexibility if they use F326 directly.

There are three key elements to remember:

- The required ventilation capacity is determined by projected occupancy of the house. Bedroom counts are used to determine occupancy.
- Ventilation requirements are tied to the type of fuel-fired heating and hot water equipment installed in the house. The key issue is the potential for backdrafting or spillage from combustion equipment due to negative pressure ventilation strategies.
- The 2005 NBC has defined performance requirements for ventilation equipment and installation to ensure better operational performance.

Ventilation Capacity

Ventilation capacities are determined by bedroom counts. There are both minimum and maximum ventilation amounts to avoid oversizing of systems. The capacities were set to try to minimize the variety and number of fans needed (Table 9.32.3.3 Normal Operating Capacity of Principal Ventilation Fan from Section 9.32.3 of the NBC shown below).

# of Bedrooms	Principal Ventilation Capacity at 62 Pa for Exhaust Fans	
	Minimum, L/s	Maximum, L/s
1	16	24
2	18	28
3	22	32
4	26	38
5	30	45

Table 9.32.3.3 Normal Operating Capacity of Principal Ventilation Fan from Section 9.32.3 of the NBC.

Examples:

> A fan with a capacity of 24 L/s (50 cfm) at 62 Pa would be suitable for use in houses with 1–3 bedrooms.

> A fan with a capacity of 30 L/s (63 cfm) at 62 Pa would be suitable for use in houses with 3–5 bedrooms.

Note: These are installed capacities – the responsibility of HVAC contractors and builders is to ensure that the installed fans provide this ventilation rate. Timers or other controls can be used to allow homeowners to operate the fans at lower rates. The ventilation system must have clearly marked control switches located in an occupied zone to allow homeowners to turn them on or off.

Ventilation and the Potential for Combustion Spillage

Ventilation options are impacted most by the potential for spillage of combustion products.

Option 1	Option 2
Houses with any spillage-susceptible, fuel-fired appliances including: • Mid-efficiency gas furnaces. • Natural-draft water heaters. • Chimney-vented oil furnaces and water heaters. • Gas log sets or gas fireplaces with doors that open or vent through conventional chimneys. Note: Solid fuel (wood) burning fireplaces are allowed under Option 2.	Houses with all non-spillage-susceptible, fuel-fired appliances including: • High-efficiency gas furnaces. • Power-vent or direct-vent water heaters. • Side-wall-vented oil furnaces and water heaters. • Direct-vent gas fireplaces. • All electric houses – heat and hot water. • Wood-burning fireplaces are allowed under this option with specific requirements.

Other NBC Performance Requirements

> Fans and HRVs used as the principal ventilation system must be rated at higher static pressures 62 Pa (0.25 in. wg). These better reflect actual installed conditions.

> Fans used as the principal ventilator must meet specific sound ratings that are typically quieter

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than the old code. Fortunately, the HVI-Certified ratings are now specifically referenced in the code as an alternate to the seldom-used Canadian Standards Association (CSA) C260 Standard.

- Additional or supplemental ventilation requirements are much simpler to understand.
- Each bathroom needs at least a 25 L/s fan or must be vented as part of the principal ventilation system.
  - The kitchen must have at least a 50 L/s fan or the principal ventilation fan can be used for the kitchen (only if the fan is not connected to any other location).
  - All supplemental fans must have a manual switch in the room where they are located – this means bathrooms served by a central exhaust fan or HRV need a manual switch for the central system in each bathroom.

Ventilation Highlights for Option 1	Ventilation Highlights for Option 2

• Each exhaust appliance in the house must have a matching makeup air supply. This includes dryers, range hoods and bath fans.
• The makeup air must be interlocked to the exhaust device.
• A carbon monoxide detector is required in each room that has a solid fuel (wood) burning appliance.
• OR: Makeup air can be avoided if an approved spillage test (sometimes called a depressurization test) is done to show the exhaust appliances won't cause spillage of the chimney-vented appliances.
• The principal ventilation system must have provisions for both exhaust and supply, and distribute fresh air to the house at the required ventilation capacity.
• The fresh air can be distributed through a forced-air heating system or a separate duct system.
	• There are no makeup air requirements for any exhaust appliances.
	• A carbon monoxide detector is required in each room that has a solid fuel (wood) burning appliance.
	• The principal ventilation system can be an exhaust-only fan system.
	• To distribute fresh air, there are three options:
	  • Interlock the exhaust fan with the operation of a forced-air heating system.
	  • Put a timer mechanism on the furnace fan that activates it at user-selected intervals.
	  • A centrally located exhaust fan can be ducted to each bedroom and at least one principal living area.
	The obvious simplicity of Option 2 will encourage builders to move towards non-chimney heating and hot water systems.

To Summarize:

> Section 9 of the NBC represents a prescriptive path for ventilation systems. Designers can always use the more comprehensive and flexible CSA F326 Ventilation Standard.

In Conclusion

Although the ventilation requirements for the United States and Canada are somewhat different, the intention in both cases is clear – to ensure that homes have the capacity to provide sufficient ventilation to keep their occupants healthy and homes safe. In all cases, make sure that ventilation systems are carefully sized to meet the effective code requirements, that the equipment selected bears the HVI-Certified label and that it is installed to meet manufacturers' requirements to assure long-term homeowner satisfaction.

Manufacturers' Directory

HVI Member Companies

(Those with HVI-Certified products appear in BOLD.)

A.O. Smith Electrical Products Co.
www.aosmithmotors.com

Abreezo
www.abreezo.com

Acme Miami
www.acmemiami.com

Active Ventilation Products
www.roofvents.com

Aeroflo Inc./Continental Fan
www.aeroflo.com

Air 2000
www.air2000.ca

Air King Ventilation Products
www.airkinglimited.com

Air Tech Equipment Ltd.
www.humidex.ca

AIRIA Brands
www.lifebreath.com

American Aldes Ventilation
www.americanaldes.com

Broan-NuTone LLC
www.broan-nutone.com

Cypress Technology Inc.

Dacor
www.dacor.com

ebm-papst Inc.
www.ebmpapst.com

Excellent Lavatory Equipment (Dong Guan) Co., Ltd.

Fantech Inc.
www.fantech.net

Festa Manufacturing Enterprises LLC
www.festaradontech.com

Fuji Industrial USA Inc.
www.fujioh.com

GE Consumer & Industrial
www.ge.com

Genuin Electric Co. Ltd.
www.genuin.com

Haier America
www.haieramerica.com

Continued on page 34

Manufacturers' Directory, *continued*

Hangzhou Aupu Electrical Appliances Co. Ltd.
www.aupu.cn

Heyoka Solutions LLC
www.heyokasolutions.com

Honeywell International
http://yourhome.honeywell.com

Hunter Fan Company
www.hunterfan.com

Imperial Air Technologies
www.imperialgroup.ca

King of Fans Inc.
www.kingoffans.com

Lonon USA
www.lonon.com.cn

Magnavent Inc./Fan Am Inc.
www.magnavent.com

Maico Italia SpA
www.elicent.it

Marley Engineered Products
www.marleymep.com

National HVAC Products Inc./Airex
www.airex.ca

North American Range Hoods Inc./Cyclone Range Hoods
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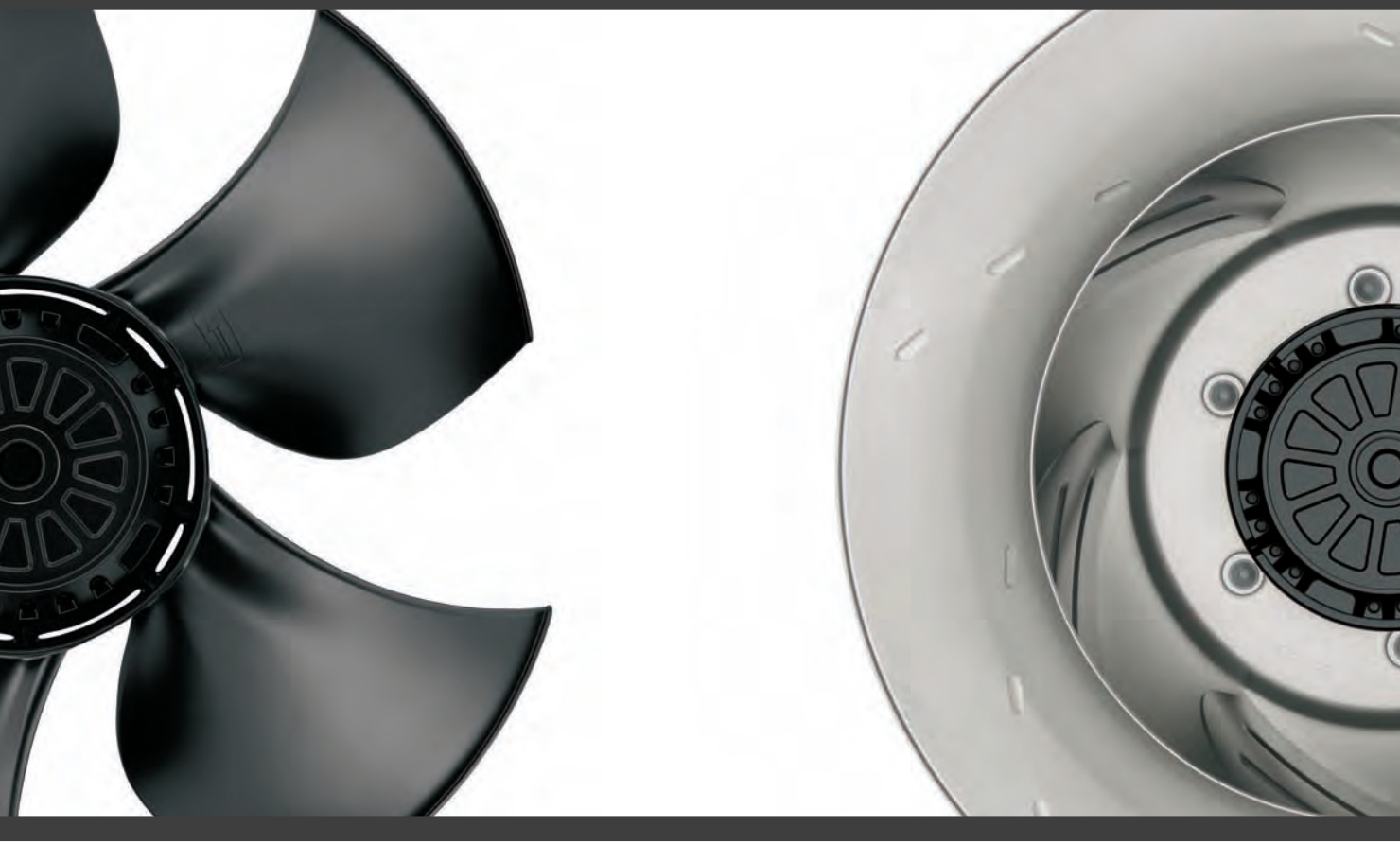

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