Home Ventilating Institute (HVI)® Indoor Air Quality (IAQ) Position Paper

Mechanical ventilation plays a critical role in maintaining acceptable indoor air quality in homes. In this article, the Home Ventilating Institute, the authority on residential ventilation systems, offers guidelines on how to select the right ventilation system for your home, how much air it should move and why, types of ventilation systems, and where to get more information on ventilation standards.

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Residential ventilation is critical to achieving the best possible indoor air quality.

- HVI recognizes that ventilation is a vital component for the durability of every home and the health of its occupants.

Background

As homes get tighter the quality of the indoor air becomes an increasingly important factor for the health and comfort of the occupants. Closing the door on the outside world closes the occupants into a chamber filled with pollutants and other undesirable components, some of which are known carcinogens and many of which are harmful to the occupants over the long-term. Most of these pollutants cannot be seen and many can't be smelled or sensed in any way. Bad air has the greatest effect on the youngest occupants and others who are particularly susceptible to the effects of the polluted air that might be present. Limiting the sources of pollution and controlled ventilation are both required to improve the indoor air quality.

The Home Ventilating Institute (HVI) is a trade association founded in 1955 representing a wide range of home ventilating product manufacturers throughout the United States, Canada, Asia, and Europe, producing the majority of the residential ventilation products sold in North America. HVI and its members are committed to providing the best indoor air quality (IAQ) to the consuming public.

Using ventilation to improve indoor air quality is a process of dilution, operating on the assumption that the outdoor air is cleaner than the indoor air. The home's ventilation system mixes the cleaner outdoor air with the more polluted indoor air, with the polluted air being exhausted to the outside. Because the materials and the occupants in the house continue to add pollutants to the indoor air, the dilution process needs to be continuous to keep the air in the home as clean as possible. Ideally, the rate of mechanical ventilation will be exactly right to meet the generation of pollutants in the home. Because of the enormous variations in homes, their locations, and how their occupants choose to live, it is difficult to select a uniform ventilation rate that will suit all homes under all conditions.

- HVI recognizes American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE) Standard 62.2-2007 *Ventilation and Acceptable Indoor Air Quality in Low-Rise Residential Buildings* as the U.S. ventilation standard, accepts that this standard is the minimum acceptable ventilation rate and recommends that it be regarded as such. This rate takes into account a combination of mechanical fans and air leakage into the home (infiltration). Infiltration varies from home to home and changes with weather conditions, therefore HVI recommends using mechanical fans (not infiltration) for the total rate required to ensure that the minimum ASHRAE ventilation rate.

Mechanical and Passive Ventilation ("Build tight – Ventilate right")

When energy was very inexpensive, tightly built houses were rare. The available materials and tools made it difficult to achieve very tight home construction. Mechanical ventilation systems were not particularly necessary except for spot ventilation in bathrooms and kitchens to expel odors, fumes, and smoke.

Building scientists have recognized the fact that if a house is built tightly, the rate of ventilation can be more easily controlled, the occupants are more comfortable, and the cost of operating the home is reduced. In order to reduce the amount of mechanical ventilation necessary,

building codes and standards have generally allowed for the fact that houses won't be completely tight, and that there will be some natural leakage or drafts that will supply some fresh air.

Natural ventilation is dependent on a number of factors, including the tightness of the building, weather conditions, occupant behavior, and how occupants operate their mechanical equipment. The tighter the house is, the lower the possibility of natural leakage. Building and energy codes have set limits on the looseness of homes, requiring openings to be sealed and insulation and draft barriers to be installed properly.

Poorly sealed ducting can play a major role in the high energy costs and inadvertent ventilation of the building. If the ducting in the home is sealed tightly, the equipment will operate much more effectively and there will be fewer problems with pressurization and depressurization in the house. Pressurization issues cause an array of serious problems, but they also cause air to leak in and/or out of the house when the system is running.

Whether the ducting is tight or leaky, the HVAC system will be run more in the summer and the winter than it will in the spring and fall. So it is when the weather is mild that the conditions are the least likely for natural ventilation. Windows may be closed, the HVAC system may not be running, and the weather may be calm with no winds blowing on the house.

Reliable, year round ventilation should be mechanical.

- HVI supports ventilation rates for IAQ based on mechanical ventilation and not reliant upon occupant behavior or natural air flows.

HVI recommends the following rates[1] as minimum, intermittent exhaust airflow rates for residential ventilation.

Bathroom:
1 cfm (cubic feet per minute) per square foot for bathrooms up to 100 square feet. For larger bathrooms, HVI recommends sizing the ventilation by the appliances:

Toilet	50 cfm
Shower	50 cfm
Bath Tub	50 cfm
Jetted Tub	100 cfm

Kitchen:

For hoods located against a wall	40 to 100 cfm per linear foot of cooktop
For "island" hoods	50 to 150 cfm per linear foot of cooktop

These are "spot" ventilation rates, ventilation systems that are located at the source of the "pollutant", like a space suit that treats the air pollutants where they are generated. It is unlikely

[1] *Achieving these rates requires calculating cubic feet of the room to be ventilated and the static pressure, or resistance, in the duct run. Static pressure is a factor of duct length, duct materials, number and radius of duct bends and the termination device, or exterior hood.*

that these fans will be running for hours so their ventilation rates are primarily recommended to remove the pollutants quickly and effectively.[2]

Types of Ventilation Systems

Continuous ventilation can be accomplished with mechanical exhaust or supply only, or "balanced" ventilation. In effect, all ventilation systems are "balanced" since the amount of air moving into the house has to equal the amount of air moving out of the house. Balancing the system mechanically assures that the air will come in and go out where it is needed. Tight houses allow for very effective IAQ control. By exhausting air at the source of pollution, the pollutants have the least effect on the overall air in the home. Adding fresh air to bedrooms will help people to breathe more comfortably while they are sleeping.

There are three types of integrated, balanced ventilators: Heat Recovery Ventilators (HRV) and Energy Recovery Ventilators (ERV), and Integrated Supply and Exhaust Ventilators (ISEV). An HRV recovers the heat or the cold from exhaust air stream transferring it to the supply air stream without mixing the two streams. An ERV also recovers the heat or the cold from the exhaust air but it also transfers moisture to the drier air stream. In climates that require a lot of air conditioning an ERV reduces the amount of moisture brought into the house, limiting the air conditioning load. In a heating season, an HRV more effectively reduces moisture in the home. An ISEV will remove indoor air and supply outdoor air, which may be achieved with or without heat or moisture recovery.

Indoor air quality includes not only quality of the air in the home but also the effects of noisy mechanical equipment in the homes. Tight homes are also quieter homes.

- HVI recognizes that ventilation systems that operate at lower sone (a detailed measurement of sound) levels are more likely to be used and have a better effect on quality of the air.

Ventilation Standards

The ASHRAE Standard 62.2-2007 sets minimum ventilation rates for continuous, whole house ventilation as well as for "spot" ventilation from the bathroom and kitchen. It also addresses many other ventilation issues such as attached garages, transfer air between rooms, filtration and air inlets.

The whole building ventilation rate in ASHRAE Standard 62.2-2007 is stated in formulas as 1 cfm (cubic feet per minute) per 100 square feet of floor area plus 7.5 cfm per bedroom, assuming two people in the first bedroom and one person in each additional bedroom.[3]

This is calculated as:

Master bedroom = 7.5 cfm x 2
Other bedrooms = 7.5 cfm each
Plus 1 cfm per 100 square feet of home
Sound level: less than or equal to 1.0 sone

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[2] *To optimize the performance of all fans, HVI recommends designing a duct run as short as possible with a smooth inner surface duct, like galvanized pipe (for remote mounted fans or HRVs/ERVs a section of insulated flexible duct is recommended for preventing transmission of vibrations). Additionally, all exhaust fans must terminate on the outside of the building envelope, and they should be sloped to allow any condensation inside the duct to run to the outside.*

[3] *Note that these rates include an "infiltration credit" for ventilation provided by infiltration of 2cfm/100ft2 of occupiable floor space." As noted earlier, infiltration cannot be relied upon throughout the year.*

There are many new green building initiatives. All of these initiatives have ventilation components, most of them based on ASHRAE 62.2. The U.S. Environmental Protection Agency's (EPA) Energy Star with Indoor Air Package program is a leader in green building through education, product guidelines and building guidelines. While Energy Star building guidelines may vary by state as the guidelines are adopted by state energy and building programs, Energy Star product guidelines are standard and have become recognized worldwide.

HVI Certification

Energy Star recognizes HVI as the authority on residential ventilation and incorporates the Certified Home Ventilating Products Directory® as the guideline for cfm/watt and sones.

The HVI-Certified Ratings Program was created to provide a fair and credible method of comparing ventilation performance of similar products. Not only are products certified, but a random verification program ensures that those products still meet their original performance. All testing for certification and verification is performed by laboratories independent of any manufacturer. The test standards utilized for testing are, in most cases, developed by HVI using national and international consensus methods. In a few cases, test standards previously developed by other agencies are recognized and adopted by HVI. A complete list of HVI-Certified products and manufacturers can be found in the HVI-Certified Products Directory on this website.

HVI Certification has been accepted and recognized as the method of performance assurance by many agencies some of which are:

- Energy Star Residential Ventilation Products Program
- Energy Star Indoor Air Package
- Canadian National Building Code
- ASHRAE Standard 62.2
- 2006 Washington State Ventilation and Indoor Air Quality Code
- 2008 California Title 24 Energy Code
- Minnesota State Energy Code
- Texas State Mechanical Code
- U.S. Green Building Council LEED for Homes Program
- U.S. Department of Energy Building America Program
- U.S. Department of Housing and Urban Development
- National Electrical Manufacturers Association (NEMA)
- National Association of Home Builders (NAHB)/International Code
- Council (ICC) National Green Building Standard
- Residential Energy Services Network (RESNET) Home Rating System
- Building Performance Institute Home Rating System
- American Lung Association (ALA) Health House Program
- R2000 Housing Program – Canada
- Ontario Provincial Building Code
- British Columbia Provincial Building Code
- Quebec Provincial Building Code