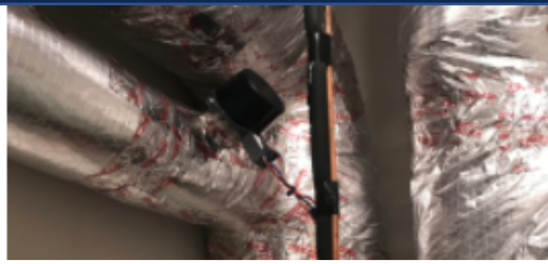
Whole-House Ventilation

2015 IECC (w/ Amendments) Inspection Guide



2015 Whole-House Ventilation Code Requirements:

Summary: The 2015 Virginia Residential Code requires Mechanical Ventilation be provided to new homes. Whole-house mechanical ventilation operates continuously or intermittently where the system has controls that enable operation for not less than 25-percent (25%) of each four (4) hour segment. The intent of these systems is to provide ongoing delivery of controlled, ideally filtered, fresh air to the living space, expel stale air, and dilute potential contaminants and improve indoor environmental quality.

Why: More people are working from home than ever and an even greater emphasis is being placed on indoor environmental quality. Whole-house ventilation is fundamentally concerned with the health and well-being of the occupants. It is estimated that people spend up to 90% of their time indoors. To maintain healthy, productive indoor environments, homes need a controlled means of bringing in fresh air and removing stale air on a regular schedule to ensure some dilution of contaminants and dissipation of odors.[1] There are several strategies commonly used to bring in whole-house ventilation: supply, exhaust, and energy recovery ventilation. Depending on the strategy and product utilized, fresh air systems consist of air intake (**Code Sections: M1602.1, M1602.2**) and outlet vents, filters, ducts, controls, and fans (**Code Section: R403.6.1**). The strategy and system chosen should take into account exterior temperature variations, desired indoor and prevalent outdoor humidity conditions, house configuration, and design objectives for the quantity and quality of air delivered.[2] Each system has its advantages and disadvantages – see the table below for more information.

Ventilation System	Pros	Cons
Exhaust	• Relatively inexpensive and simple to install • Work well in cold climates.	• Can draw pollutants into living space • Not appropriate for hot humid climates • Rely in part on random air leakage • Can increase heating and cooling costs • May require mixing of outdoor and indoor air to avoid drafts in cold weather • Can cause back drafting in combustion appliances.
Supply	• Relatively inexpensive and simple to install	• Can cause moisture problems in cold climates

[1] https://basc.pnnl.gov/building-science-measures/dilution-whole-house-ventilation
[2] https://basc.pnnl.gov/building-science-measures/properly-installed-whole-house-ventilation

Supply (cont'd)	• Allow better control than exhaust systems • Minimize pollutants from outside living space • Prevent backdrafting of combustion gases from fireplaces and appliances • Allow filtering of pollen and dust in outdoor air • Allow dehumidification of outdoor air • Work well in hot or mixed climates.	• Will not always temper or remove moisture from incoming air • Can increase heating and cooling costs • May require mixing of outdoor and indoor air to avoid drafts in cold weather.
Energy Recovery & Heat Recovery Ventilators	• Reduce heating and cooling costs • Available as both small wall- or window-mounted models or central ventilation systems • Allows filtering of outdoor air • Cost-effective in climates with extreme winters or summers and high fuel costs.	• Can cost more to install than other ventilation systems • May not be cost-effective in mild climates • May be difficult to find contractors with experience and expertise to install these systems • Require freeze and frost protection in cold climates • Require more maintenance than other ventilation systems.

Table 1: Pros and Cons of Various Mechanical Ventilation Systems[3]

Indoor air quality and ventilation needs vary greatly from home-to-home and the following factors should be considered:

* **Occupancy:** A house or apartment with one occupant has different ventilation needs than a household of five or more
* **Occupant susceptibility:** Some people are more susceptible than others to contaminants. Pollutant levels that cause an asthma attack in one person may cause no problems for someone else
* **Building characteristics:** The size, shape, design, and materials used in a building affect air leakage rates and pollutant sources
* **Pollutant load:** Each house and apartment have different sources and levels of indoor pollutants
* **Weather:** Temperature, wind, and humidity vary throughout the year in any single location and in different climate zones. Each of these weather factors affects indoor air quality[4]

Notes:

* *Mechanically providing fresh air to the space is in reality an energy penalty. We pay to heat and cool the raw air brought into the home and can, if not done properly, increase relative humidity within the living space. These systems require careful design and commissioning to ensure proper function and prevent over-ventilation.*

[3] https://www.energy.gov/energysaver/weatherize/ventilation/whole-house-ventilation
[4] https://homes.lbl.gov/ventilate-right/ventilation-and-health

* *Best Practices:*
    1. *Design for positive pressure or balanced in our climate zone*
    2. *Do not suck on buildings in our climate zone (negative pressure/exhaust systems)*
        - ***BSI-069: Unintended Consequences Suck***

Mechanical Whole-house Ventilation Visual:

Image 1: Exhaust Ventilation Strategy – requires controls to ensure run times are met.

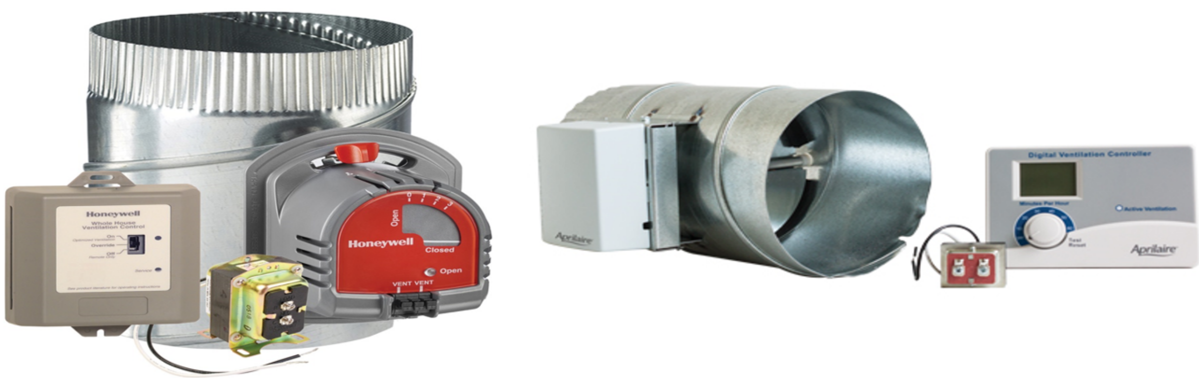


Image 2: Common Supply Ventilation Systems – duct run from exterior to return plenum, automated mechanical damper and controls

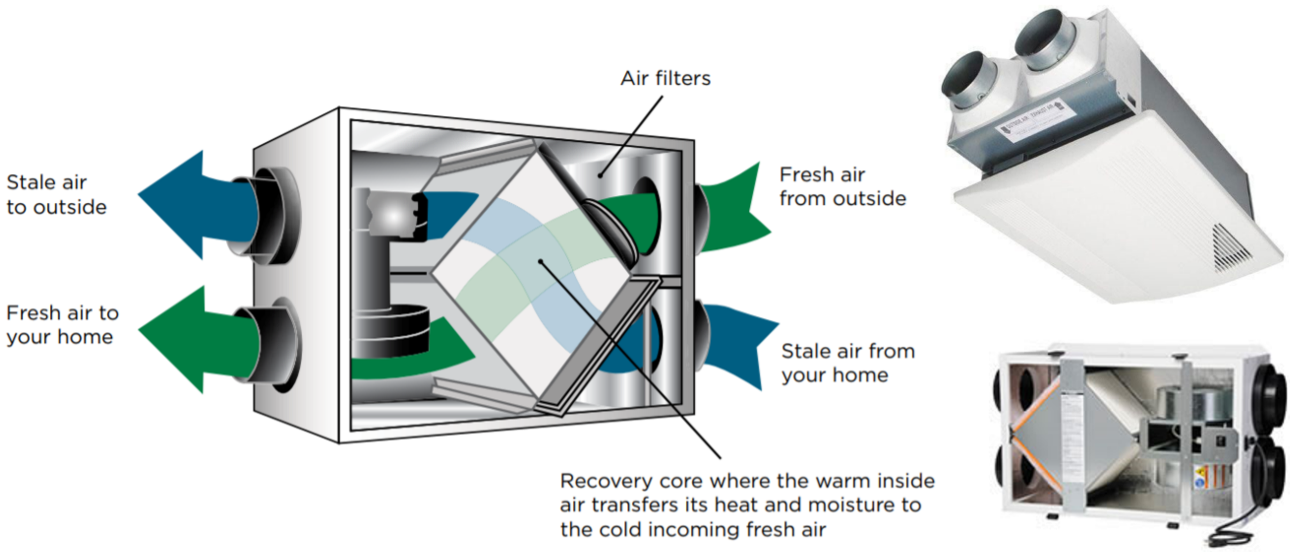


Image 1: Balanced Ventilation Strategy utilizing heat or enthalpy recovery

Whole-House Ventilation Code Reference:

Section M1507.1 Mechanical Ventilation. General. Where local exhaust or whole-house mechanical ventilation is provided, the equipment shall be designed in accordance with this section.

Section M1507.3 Whole-house mechanical ventilation system. Whole-house mechanical ventilation systems shall be designed in accordance with Sections M1507.3.1 through M1507.3.3

M1507.3.1 System Design. The whole-house ventilation system shall consist of one or more supply or exhaust fans, or a combination of such, and associated ducts and controls. Local exhaust or supply fans are permitted to serve as such a system. Outdoor air ducts connected to the return side of an air handler shall be considered as providing supply ventilation.

M1507.3.2 System Controls. The whole-house mechanical system shall be provided with controls that enable manual override.

M1507.3.3 Mechanical ventilation rate**.** The whole-house mechanical ventilation system shall provide outdoor air at a continuous rate of not less than that determined in accordance with Table M1507.3.3(1).

> ***Exception:*** The whole-house mechanical ventilation system is permitted to operate intermittently where the system has controls that enable operation for not less than 25-percent of each 4-hour segment and the ventilation rate prescribed in Table M1507.3.3(1) is multiplied by the factor determined in accordance with Table M1507.3.3(2)

DWELLING UNIT FLOOR AREA (square feet)	NUMBER OF BEDROOMS				
	0 – 1	2 – 3	4 – 5	6 – 7	> 7
	Airflow in CFM				
< 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 1507.3.3(1) Continuous whole-house ventilation system airflow rate requirements

RUN-TIME PERCENTAGE IN EACH 4-HOUR SEGMENT	25%	33%	50%	66%	75%	100%
Factor[a]	4	3	2	1.5	1.3	1.0

a. For ventilation system run time values between those given, the factors are permitted to be determined by interpolation.

b. Extrapolation beyond the table is prohibited.

Table 1507.3.3(2) Intermittent whole-house mechanical ventilation rate factors.

Section R403.6.1 Whole-house mechanical ventilation system fan efficacy. When installed to function as a whole-house mechanical ventilation system, fans shall meet the efficacy requirements of Table R403.6.1

> ***Exception:*** Where whole-house mechanical ventilation fans are integral to tested and listed HVAC equipment, they shall be powered by an electronically commutated motor.

FAN LOCATION	AIR FLOW RATE MINIMUM (CFM)	MINIMUM EFFICACY[a] (CFM/WATT)	AIR FLOW RATE MAXIMUM (CFM)
Range hoods	Any	2.8 cfm/watt	Any
In-line fan	Any	2.8 cfm/watt	Any
Bathroom, utility room	10	1.4 cfm/watt	< 90
Bathroom, utility room	90	2.8 cfm/watt	Any

Table R403.6.1 Whole-house mechanical ventilation system fan efficacy

Fresh Air Inlet Location Requirements Code Reference:

Section R303.5 Opening location. Outdoor intake and exhaust openings shall be located in accordance with sections R303.5.1 and R303.5.2.

R303.5.1 Intake openings. Mechanical and gravity outdoor air intake openings shall be located not less than 10 feet from any hazardous or noxious contaminant, such as vents, chimneys, plumbing vents, streets, alleys, parking lots and loading docks.

For the purpose of this section, the exhaust from dwelling unit toilet rooms, bathrooms and kitchens shall not be considered as hazardous or noxious.

Exceptions:

1. The 10-foot separation is not required where the intake opening is located 3 feet or greater below the contaminant source.
2. Vents and chimneys serving fuel-burning appliances shall be terminated in accordance with the applicable provisions of Chapters 18 and 24.
3. Clothes dryer exhaust ducts shall be terminated in accordance with Section M1502.3

Section R303.5.2 Exhaust openings. Exhaust air shall not be directed onto walkways.

R303.6 Outside opening protections**.** Air exhaust and intake openings that terminate outdoors shall be protected with corrosion-resistant screens, louvers or grilles having an opening size of not less than ¼ inch and a maximum opening size of ½ inch, in any dimension. Openings shall be protected against local weather conditions. Outdoor air exhaust and intake openings shall meet the provision for exterior wall opening protectives in accordance with this code.

Definitions:

Building Thermal Envelope: The basement walls, exterior walls, floor, roof and any other building elements that enclose conditioned space or provide a boundary between conditioned space and exempt or unconditioned space

Conditioned Space: An area, room or space that is enclosed within the building thermal envelope and that is directly heated or cooled or indirectly heated or cooled

Above-Grade Wall: A wall more than 50% above grade and enclosing conditioned space. This includes between-floor spandrels, peripheral edges of floors, roof and basement knee-walls, dormer walls, gable end walls, walls enclosing mansard roof and skylight shafts

Air Barrier: Material(s) assembled and joined together to provide a barrier to air leakage through the building envelope. An air barrier may be a single material or a combination of materials

R-Value: Resistance to Heat Flow of a single material, expressed as a whole number. Higher numbers denote higher resistance to heat flow

U-Value: Resistance to heat flow of multiple materials expressed as a decimal point. Lower numbers denote higher resistance to heat flow

Infiltration: The uncontrolled inward air leakage into a building caused by the pressure effects of wind, or the effect of differences in the indoor and outdoor air density or both

viridiant SEEA SOUTHEAST ENERGY EFFICIENCY ALLIANCE VIRGINIA DHCD