Energy Program
WASHINGTON STATE UNIVERSITY

2018 Washington State Energy Code-Residential FAQs:
Whole-House Ventilation System
(Revised 8-17-22)

What are the requirements for supplying fresh air to habitable spaces?

All homes require mechanical ventilation. Provided below is the code basis for this answer. In Section R403.6, the Washington State Energy Code adopted the ventilation requirements of the International Residential Code (IRC) (see IRC Chapter 15 Section M1505.4, "Whole-house mechanical ventilation systems," starting on page 512):

> IRC's Section M1505.4.1, "System Design," states:
> "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."

We have bolded the "or"s in this section to emphasize that the system may be exhaust-only, supply-only, ***or*** a combination of exhaust and supply.

For all types of ventilation systems, use Tables M1505.4.5(1) to M1505.4.5(3) in the IRC to determine the required airflow of the system. In particular, notice the system coefficient in Table M1505.4.5(2). If, for example, the system is not balanced (exhaust-only or supply-only) and not distributed (does not have fresh air supplied to each habitable space and exhaust from kitchens and bathrooms), you must apply a multiplier of 1.5 to the airflow determined from Tables M1505.4.5(1) and (2).

At the end of this FAQ are screenshots of these three tables from the IRC used for sizing the fan. The latest version of our Excel-based Code Compliance Calculator, which you can download from our energy code website, includes a ventilation calculator to assist you with using these tables.

Are inlet ports in walls and windows required for make-up air? No.

Fresh air intakes are not required for make-up air because houses are never airtight; air seeps in through cracks all around the house, no matter how tightly it is built. The code basis for this is Section M1504.4, which allows exhaust-only ventilation with no mention of air inlets.

Inlet air ports used to be required, often as slots in window frames or wall ports. But it was determined that these were not necessary due to natural infiltration. They also result in comfort problems so people often plugged them up.

Note: The International Mechanical Code does require make-up air for kitchen fans exceeding 400 cfm.

How do I meet the requirements for Option 2.1 in Table 406.3 of the 2018 WSEC?

Option 2.1 has two requirements:

- The whole-house ventilation fan must be a high-efficiency fan (0.35 watts/cfm). You can search for specific models of high-efficiency ENERGY STAR-rated exhaust fans at the ENERGY STAR website. Look for an efficacy of 2.9 cfm/watt or above, which is equivalent to the code-required maximum of 0.35 watts/cfm or above.
- The building or dwelling unit must pass a blower door test with a maximum tested air leakage rate of 3.0 air changes per hour at 50 Pascals (ACH_{50}).

Is an HRV or ERV required for Options 2.2 to 2.4 in Table 406.3 of the 2018 WSEC? Yes

A heat recovery ventilation (HRV) or energy recovery ventilation (ERV) system is required in Options 2.2, 2.3, and 2.4. This is a frequent point of confusion because the text of these options is not clear. The "or" only provides two different measurement options for R-2 occupancies and does not make the HRV optional.

Taking Option 2.2 as an example, when the text is arranged like this, the two requirements of (1) air leakage sealing and (2) HRV are less confusing:

1. Reduce the tested air leakage to 2.0 ACH_{50} (maximum) **OR**, for R-2 occupancies, optional compliance based on Section R402.4.1.2, reduce the tested air leakage to 0.25 cfm/sf maximum at 50 Pascals

AND

2. All whole-house ventilation requirements as determined by Section M1505.4 of the IRC 2018* or Section 403.8 of the International Mechanical Code (IMC) shall be met with a HRV system with minimum sensible heat recovery efficiency of 0.65.

Ventilation systems using a furnace or central heat pump including an electronically commutated motor (ECM) are allowed, provided that they are controlled to operate at low speed in ventilation-only mode.

**Note: the IRC section number has been corrected in the Option 2.2 text above. IRC 2015 Section M1507.3 Whole-House Mechanical Ventilation System" corresponds to IRC 2018 Section M1505.4 "Whole-house mechanical ventilation system."*

Can a bathroom exhaust fan be used for whole-house ventilation? Yes.

The simplest option that meets the minimum code baseline and Option 2.1 requirements is an exhaust-only fan on a timer set to run continuously or for a certain fraction of each hour. An exhaust fan in the bathroom, utility room, or kitchen is typically used for this purpose. Fresh air intakes are not required for make-up air. Multiply the air flow rate by 1.5 per Table M1504.3(2) for an unbalanced, undistributed system.

Can a continuous or intermittent exhaust fan be used? Yes.

For Option 2.1, you can use a continuous or intermittent exhaust fan. An exhaust fan in the bathroom, utility room, or kitchen is typically used for this purpose. If the time is set for intermittent operation, use the factors in Table M1505.4.5(3) to increase the flow rate accordingly. For example, for 50% run time, the required air flow rate is doubled.

A HRV system is required only if claiming Options 2.2, 2.3, ***or*** 2.4.

How do I determine the sensible heat recovery efficiency of a HRV or ERV system?

You can find the rated sensible recovery efficiency (SRE) of HRV/ERVs in Section III of the Home Ventilation Institute's product directory. Click the "Model Details" link for any given model and look up the Adjusted Sensible Recovery Efficiency (ASRE) for your unit in the Energy Ratings table.

For more information on the SRE, how it is defined, and how it is determined, refer to the State Building Code Opinion No. 20-14.

What is the definition of "distributed"?

A whole-house ventilation system is considered distributed "when it supplies outdoor air directly (not transfer air) to each dwelling or sleeping unit habitable space (living room, den office, interior adjoining spaces, or bedroom), and exhausts air from all kitchens and bathrooms directly outside."

When air is supplied directly to a space, it is delivered either directly from the fan or HRV/ERV unit or via ductwork from the unit. In contrast, "transfer air" refers to air that is transferred to a space from an adjacent space through the use of transfer grilles or other openings. Similarly, air directly exhausted to the outside may be exhausted by a fan directly outdoors or via ductwork to the outdoors.

To be considered distributed, the system must supply ventilation air to ***all*** dwelling and sleeping spaces in the home, and exhaust air from ***all*** kitchens and bathrooms directly.

Example: What is the design airflow rate for a 2,400 sf, three-bedroom home ventilated using an exhaust-only fan in a bathroom with a timer set for 50% run time?

From Table M1505.4.3(1), the base ventilation airflow rate is 55 cfm. This needs to be multiplied by 1.5 because it is unbalanced and not distributed, per Table M1505.4.3(2), and then multiplied by 2 because it runs only half the time, per Table M1505.4.3(3). Therefore, the design airflow rate is:

55 x 1.5 x 2 = 85 cfm

To do this calculation using our Excel-based Code Compliance Calculator (C3), available from our website, only a few inputs are required. Go to the "Group R" tab after opening the workbook by enabling macros and accepting the terms. Then select your Occupancy Type in Row 17 (either R-3 Single Family Homes and Duplexes or R-2 Multifamily) and enter the conditioned floor area of your home on Row 62. Next, complete the inputs in the section "Ventilation Requirements" starting on Row 216. If you just want to size your ventilation system airflow, you can ignore all the other inputs.

Watch the how-to video on using the C3 calculator to calculate ventilation rates here.

TABLE M1505.4.3(1)
WHOLE-HOUSE MECHANICAL VENTILATION AIRFLOW RATE

Dwelling Unit Floor Area (square feet)	Number of Bedrooms				
	0 - 1	2	3	4	5 or more
	Airflow in cfm				
< 500	30	30	35	45	50
501 - 1,000	30	35	40	50	55
1,001 - 1,500	30	40	45	55	60
1,501 - 2,000	35	45	50	60	65
2,001 - 2,500	40	50	55	65	70
2,501 - 3,000	45	55	60	70	75
3,001 - 3,500	50	60	65	75	80
3,501 - 4,000	55	65	70	80	85
4,001 - 4,500	60	70	75	85	90
4,501 - 5,000	65	75	80	90	95

TABLE M1505.4.3(2)
SYSTEM COEFFICIENT (C_{system})

System Type	Distributed	Not Distributed
Balanced	1.0	1.25
Not balanced	1.25	1.5

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TABLE M1505.4.3(3)
INTERMITTENT OFF WHOLE HOUSE-MECHANICAL VENTILATION RATE FACTORS[a,b]

Run-time % in Each 4-hour Segment	50%	66%	75%	100%
Factor[a]	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.

Equation 15-2

$$Q_v = Q_r * C_{system}$$

Where:

Q_v = Quality-adjusted ventilation airflow rate in cubic feet per minute (cfm).

Q_r = Ventilation airflow rate, cubic feet per minute (cfm) from 15-1 or Table M1505.4.3(1).

C_{system} = System coefficient from Table 1505.4.3(2).

Tables M1505.4.5(1) to M1505.4.5(3) and Equation 15-2 from the IRC

For more information

Email your question to us at energycode@energy.wsu.edu or call (360) 956-2042.

Visit the WSUEPs Energy Code website at www.energy.wsu.edu/BuildingEfficiency/EnergyCode.aspx.

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