


Washington Association of Building Officials

Multifamily Mash-up


2021 WSEC Commercial & Residential Comparison

Jonathan Jones & Rick Blumenthal, WSU Energy Extension
(360) 956-2042 | energycode@energy.wsu.edu

Lisa Rosenow, Evergreen Technology Consulting
Duane Lewellen, Lewellen Associates
(360) 539-5300 | com.techsupport@waenergycodes.com



1




Multifamily Mash-Up

This presentation's purpose is to guide the perspective viewer through a summary review of the WSEC-R and how it is utilized in multifamily permitting for Washington State's Energy Code.

1. Rick Blumenthal's Journey through the building envelope.
2. Energy credit's and required commissioning
3. Ventilation (Energy Code, IRC, and IMC)

Conclusion & Questions



2

Multifamily Mash-up

2021 WSEC Commercial & Residential Comparison

Rick Blumenthal

WSU Energy Program
WABO 2021 WSEC-R REVIEW



3



2021 WSEC-R RESIDENTIAL BUILDING TYPES


Section R202:

RESIDENTIAL BUILDING - For this code, the following building types are residential buildings:

1. Detached one- and two-family dwellings.
2. Multiple single-family dwellings (townhouses).
3. Group R-3 occupancy areas in buildings *three stories or less* in height above grade plane whose dwelling *units are accessed directly from the exterior*.
4. Group R-2 occupancy areas in buildings *three stories or less* in height above grade plane whose dwelling *units are accessed directly from the exterior*.
5. Accessory structures to residential buildings. Group R-2 buildings with dwelling *units accessed from interior corridors or other interior spaces are not residential buildings*.



4



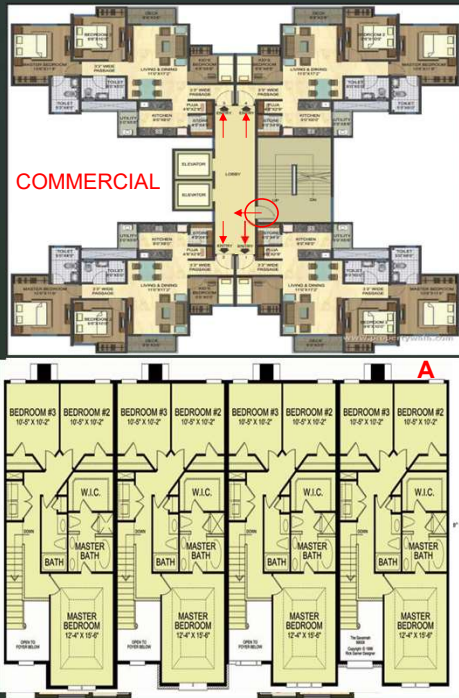
R401.1 SCOPE.

- Group R-2 occupancy areas with dwelling units *accessed from enclosed interior corridors or other enclosed interior spaces must comply with the Washington State Energy Code (WSEC), Commercial Provisions.*
- Other Group R-2 occupancy areas are permitted to comply with the WSEC, Commercial Provisions, in lieu of the WSEC, Residential Provisions.


Exception: Water heaters that each serve only an individual Group R-2 dwelling unit in a building three stories or less above grade plane are permitted to comply with the requirements of the WSEC, Residential Provisions.

I.E. – One HWH per dwelling unit = Residential Code OK

A-Pinterest, Southern Designer .com. ;



5



BUILDING LEAKAGE RATE

R402.4.1.3 Leakage rate.

- Detached one- and two-family dwellings and multiple single-family dwellings (townhouses) shall comply with Section R402.4.1.3.1.

R402.4.1.3.1 Dwelling unit leakage rate.

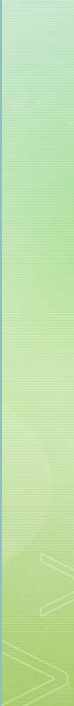
- The maximum air leakage rate *for any dwelling unit* under any compliance path *shall not exceed 4.0 air changes per hour*. Testing shall be conducted with a blower door test at a test pressure of 0.2 inches w.g. (50 Pa).

- Group R-2 multifamily buildings shall comply with Section R402.4.1.3.2.

R402.4.1.3.2 Group R-2 multifamily building leakage rate.

- For *Group R-2 multifamily buildings*, the *maximum leakage rate for any dwelling unit shall not exceed 0.25 cfm per square foot* of the dwelling unit enclosure area. Testing shall be conducted with a blower door at a test pressure of 0.2 inches w.g. (50 Pa). *Doors and windows of adjacent dwelling units (including top and bottom units) shall be open to the outside during the test.*

NOTE: Guarded testing is not allowed.



6



R403.6 Mechanical ventilation.

The buildings complying with Section R402.4.1 shall be provided with mechanical ventilation

- Meet the requirements of Section M1505 in the IRC or IMC, as applicable

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

- Ventilation system fans shall meet the efficacy requirements of Table R403.6.1
- *at one or more rating points.*
 - *Tested in accordance with HVI 916 and listed.*
 - *Fan efficacy for fully ducted HRV, ERV, balanced, and in-line fans shall be determined at a static pressure of not less than 0.2 inch w.c. (49.85 Pa)*

SYSTEM TYPE	AIR FLOW RATE (CFM)	MINIMUM EFFICACY (CFM/WATT)
HRV, ERV or balanced	Any	1.2 cfm/watt
Range hoods	Any	2.8 cfm/watt
In-line supply or exhaust fan	Any	3.8 cfm/watt
Other exhaust fan	<90	2.8 cfm/watt
	≥90	3.5 cfm/watt

For SI: 1 cfm = 28.3 L/min.
a. Design outdoor or exhaust airflow rate/watts of fan used.

R105.2.4 Mechanical rough-in inspection.

- *HVAC type & size including controls, system insulation installation & R value, system leakage control, (sealing), programmable T-Stats, whole house ventilation & fan efficiency.*



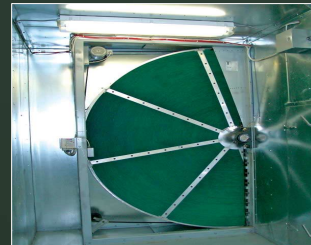
7



TABLE R406.3 ENERGY CREDITS

2. AIR LEAKAGE CONTROL AND EFFICIENT VENTILATION OPTIONS

OPTION	DESCRIPTION	ALL OTHER	GROUP R-2
2.1	<p>Compliance based on Section R402.4.1.2: Reduce the tested air leakage to <i>2.0 air changes per hour maximum</i> at 50 Pascals, or for R-2 Occupancies, optional compliance based on Section R402.4.1.2: Reduce the tested air leakage to 0.25 cfm/ft2 maximum at 50 Pascals</p> <p><i>AND</i></p> <p>All whole house ventilation requirements as determined by Section M1505.3 of the International Residential Code or Section 403.8 of the International Mechanical Code shall be met with a <i>heat recovery ventilation system with minimum sensible heat recovery efficiency of 0.65</i>. To qualify to claim this credit, the building permit drawings shall specify the option being selected, the maximum tested building air leakage, and shall show the qualifying ventilation system and its control sequence of operation.</p>	1.0	1.0



8



HEATING AND COOLING

R403.3.2 Ducts located in conditioned space.

For ducts to be considered as being located inside a conditioned space:

- *All heating, cooling and ventilation system components shall be installed inside the conditioned space*
 - *NOTE: deeply buried ducts are no longer considered as in conditioned space, there is no credit available for this in 2021. Deeply buried ducts are allowed per R403.3.3, 403.3.3.1, 403.3.4, 403.3.4.1, 403.3.5, 403.3.6 (1. – 3.)*
- Max 10 linear feet of return ducts and 5 linear feet of supply outside conditioned allowed
 - *Reference R403.3.2 (1. – 4.3 for compliance)*

TABLE R405.4.2(1)
SPECIFICATIONS FOR THE STANDARD REFERENCE AND PROPOSED DESIGNS

BUILDING COMPONENT	STANDARD REFERENCE DESIGN	PROPOSED DESIGN
Mechanical ventilation	Mechanical ventilation None, except where mechanical ventilation is specified by the proposed design, in which case: Annual vent fan energy use: kWh/yr = (1ef) × (0.0876 × CFA + 65.7 × (Nbr + 1) w	As proposed



9



INSULATION

R103.2.1 Building thermal envelope depiction. The building's thermal envelope shall be represented on the construction documents

- 3 framing types:
 - **Standard** – 16" O.C, 2 top plates, 1 bottom plate, 3 stud corner, 2 stud fenestration openings, 2x or 4x headers, 2 studs @ wall intersections @ ext. walls
 - **Intermediate** – 2 stud corner fully insulated, 2x headers with R10
 - **Advanced** – 24" O.C., wall intersections fully insulated


R303.1.1 Building thermal envelope insulation.

CONTINUOUS INSULATION - (c.i.). Insulating material that is continuous across all structural members without thermal bridges other than fasteners and service openings. *It is installed on the interior or exterior or is integral to any opaque surface of the building envelope.*

[WALLS] - *For blown or sprayed insulation* (fiberglass and cellulose), the initial installed thickness, settled thickness, settled R-value, *installed density*, coverage area and number of bags installed shall be listed on the certification. For *sprayed polyurethane foam* (SPF) insulation, the *installed thickness* of the areas covered and R-value of installed thickness shall be listed on the certification.



10



INSULATION AND FENESTRATION U FACTOR and R VALUES REQUIREMENTS BY COMPONENT

TABLE R402.1.2

CLIMATE ZONE 5 AND MARINE 4	
Fenestration U-Factor ^a	0.30
Skylight U-Factor	0.50
Ceiling U-Factor	0.024
Above-Grade Wall U-Factor	0.056
Floor U-Factor	0.029
Slab on Grade F-Factor	0.54
Below Grade 2' Depth	
Wall U-Factor	0.042
Slab F-Factor	0.59
Below Grade 3.5' Depth	
Wall U-Factor	0.040
Slab F-Factor	0.56
Below Grade 7' Depth	
Wall U-Factor	0.035
Slab F-Factor	0.50

TABLE R402.1.3


CLIMATE ZONE 5 AND MARINE 4	
Fenestration U-Factor ^{a, j}	0.30
Skylight ^a U-Factor	0.50
Ceiling R-Value ^a	60
Wood Frame Wall ^{b, i} R-Value	20+5 or 13+10
Floor R-Value	30
Below-Grade ^{b, h} Wall R-value	10/15/21 int + 5TB
Slab ^{d, f} R-Value & Depth	10, 4 ft

a. U-factors or F-factors shall be obtained from measurement, calculation or an approved source, or as specified in Section R402.1.5.


R402.1.3 R-value alternative. Assemblies with R-value of insulation materials equal to or greater than that specified in Table R402.1.3 shall be an alternative to the U-factor in Table R402.1.2.

- Continuous insulation (ci) alone shall be used to determine compliance with the continuous insulation R-value requirements in Table R402.1.3.
- Cavity insulation R-values shall not be used to determine compliance with the continuous insulation R-value requirements in Table R402.1.3.

e. For single rafter- or joist-vaulted ceilings, the insulation may be reduced to R-38 if the full insulation depth extends over the top plate of the exterior wall.

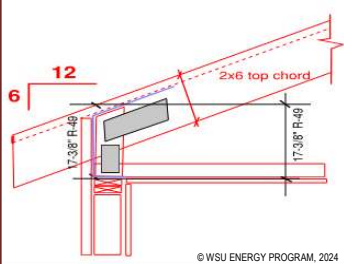


11

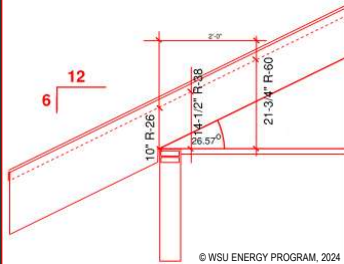


R402.2.1 Ceilings with attic spaces.


Where Section R402.1.3 would require R-60 in the ceiling or attic, *installing R-49 over 100 percent of the ceiling area requiring insulation shall satisfy the requirement for R-60 wherever the full height of uncompressed R-49 insulation extends over the wall top plate at the eaves.* This reduction shall not apply to the insulation and fenestration criteria in Section R402.1.2 and the Total UA alternative in Section R402.1.5.



© WSU ENERGY PROGRAM, 2024




© WSU ENERGY PROGRAM, 2024



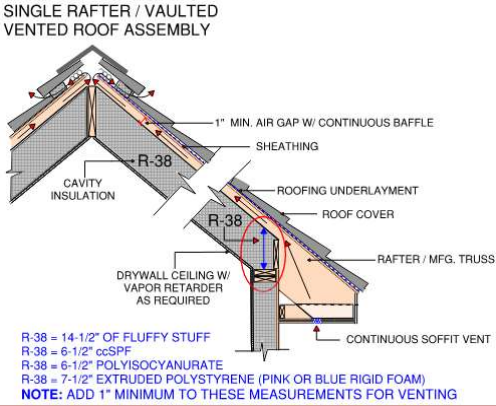
R402.2.3 Eave baffle -

For air-permeable insulation in vented attics, a baffle shall be installed adjacent to soffit and eave vents. Baffles shall maintain a net free area opening equal to or greater than the size of the vent. Where soffit venting is not continuous, baffles shall be installed continuously to prevent ventilation air in the eave soffit from bypassing the baffle.

1 - https://th.bing.com/th?id/R_e0008c4aa82cf354c5029023cbb46c1f7rik=%2bcgnj3CARMBTQ&riu=http%3a%2f%2fmodelremode2017_s3.amazonaws.com%2fs3fspublic%2fu328%2f7.jpg&ehk=Nm5qPuMGhs6ntt8G26WDVA7d1uV8pO7OocNoMCKVw%3d&isl=&pid=ImgRaw&r=0



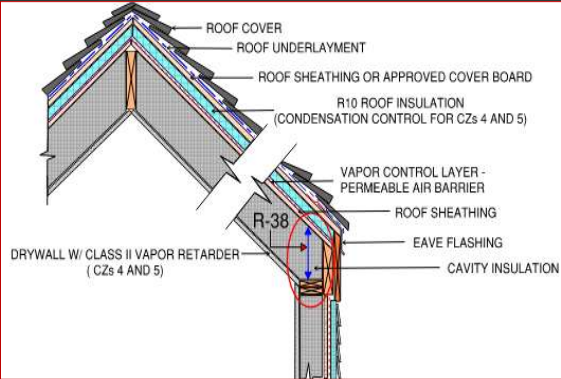
12



SINGLE RAFTER / VAULTED VENTED ROOF ASSEMBLY

Labels: 1" MIN. AIR GAP W/ CONTINUOUS BAFFLE, SHEATHING, R-38, CAVITY INSULATION, ROOFING UNDERLAYMENT, ROOF COVER, RAFTER / MFG. TRUSS, DRYWALL CEILING W/ VAPOR RETARDER AS REQUIRED, CONTINUOUS SOFFIT VENT.

R-38 = 14-1/2" OF FLUFFY STUFF
 R-38 = 6-1/2" ccSPF
 R-38 = 6-1/2" POLYISOCYANURATE
 R-38 = 7-1/2" EXTRUDED POLYSTYRENE (PINK OR BLUE RIGID FOAM)
NOTE: ADD 1" MINIMUM TO THESE MEASUREMENTS FOR VENTING



UNVENTED SINGLE RAFTER / JOIST VAULTED ROOF ASSEMBLY

Labels: ROOF COVER, ROOF UNDERLAYMENT, ROOF SHEATHING OR APPROVED COVER BOARD, R10 ROOF INSULATION (CONDENSATION CONTROL FOR CZs 4 AND 5), VAPOR CONTROL LAYER - PERMEABLE AIR BARRIER, ROOF SHEATHING, EAVE FLASHING, CAVITY INSULATION, R-38, DRYWALL W/ CLASS II VAPOR RETARDER (CZs 4 AND 5).

e. For single rafter- or joist-vaulted ceilings, the insulation may be reduced to R-38 if the full insulation depth extends over the top plate of the exterior wall.

REFERENCES TO FASTENING REQUIREMENTS W/ EXTERIOR ci

- TABLE R703.15.1, TABLE R703.15.2, TABLE R703.16.1, TABLE R703.16.2

13

TABLE R402.1.2 INSULATION AND FENESTRATION REQUIREMENTS BY COMPONENT a

CLIMATE ZONE 5 AND MARINE 4	
Fenestration U-Factor ^b	0.30
Skylight U-Factor	0.50
Ceiling U-Factor	0.024
Above-Grade Wall U-Factor	0.056
Floor U-Factor	0.029
Slab on Grade F-Factor	0.54
Below Grade 2' Depth	
Wall U-Factor	0.042
Slab F-Factor	0.59
Below Grade 3.5' Depth	
Wall U-Factor	0.040
Slab F-Factor	0.56
Below Grade 7' Depth	
Wall U-Factor	0.035
Slab F-Factor	0.50

TABLE R402.1.3 INSULATION MINIMUM R-VALUES AND FENESTRATION REQUIREMENTS BY COMPONENTS a

CLIMATE ZONE 5 AND MARINE 4	
Fenestration U-Factor ^{b, i}	0.30
Skylight ^b U-Factor	0.50
Ceiling R-Value ^e	60
Wood Frame Wall ^d R-Value	20+5 or 13+10
Floor R-Value	30
Below-Grade ^{e, h} Wall R-value	10/15/21 int + 5TB
Slab ^{d, j} R-Value & Depth	10, 4 ft


$0.056 \neq R\ 20 + 5\ \text{or}\ R\ 13 + 10$
 $\frac{1}{0.056} = 17.86$

R402.1.3 R-value alternative.
 Assemblies with R-value of insulation materials equal to or greater than that specified in Table R402.1.3 shall be an alternative to the U-factor in Table R402.1.2.

R402.1.4 R-value computation.

- Cavity insulation alone shall be used to determine compliance with the cavity insulation R-value requirements in Table R402.1.3.
- Continuous insulation (ci) alone shall be used to determine compliance with the continuous insulation R-value requirements in Table R402.1.3.
- **Cavity insulation R-values shall not be used to determine compliance with the continuous insulation R-value requirements in Table R402.1.3.**


14




THERMAL BRIDGING

*"...thermal bridging through framing components reduces insulation performance by as much as 15-20 percent in wood frame construction and by 40-60 percent in metal framed buildings."**

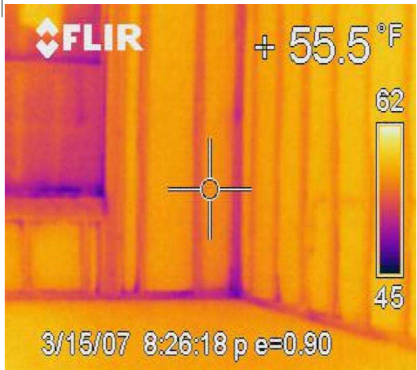
Over-framed walls like this lose a substantial amount of energy via thermal bridging. Exterior insulation overcomes much of this loss.




Melted lines on a frosty wall show the heat passing through the wall at stud locations. Exterior foam insulation would make a difference.




This infrared image shows the cold studs in a heated house on a winter day. Exterior foam insulation could prevent this source of heat loss.





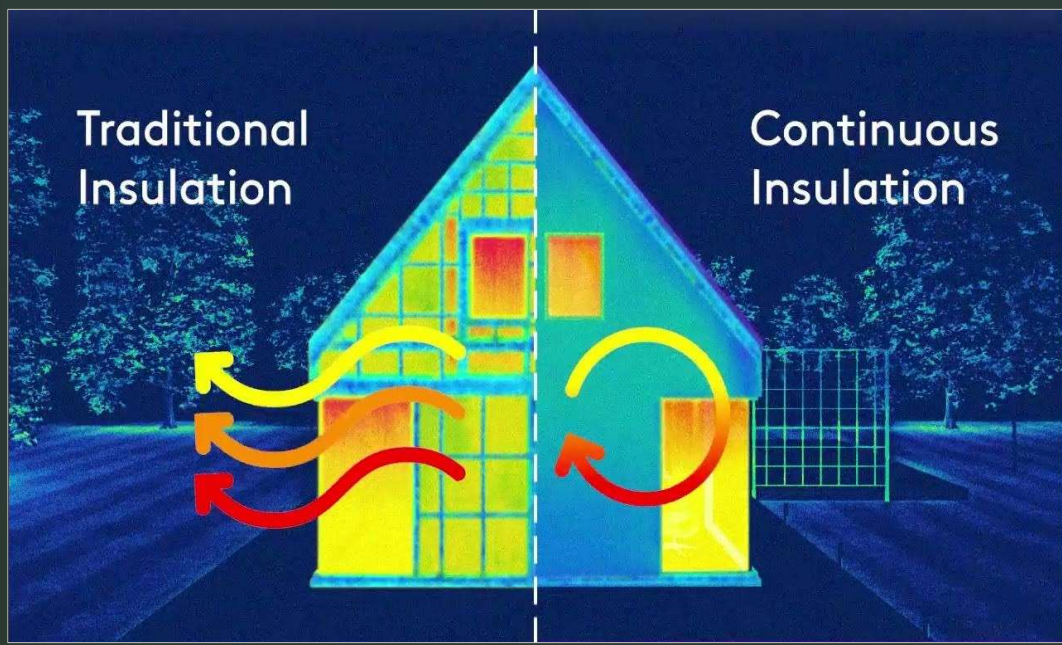
*builderonline.com/building/building-enclosure/exterior-foam-insulation-problems-and-solutions, Exterior Foam Insulation: Problems and Solutions, July 30,2020
Echotape.com, Continuous Insulation – What is it and Why Do We Care?

15




Traditional Insulation

Continuous Insulation



The diagram shows a house cross-section. On the left, 'Traditional Insulation' shows heat escaping through the wooden studs (indicated by red and orange arrows). On the right, 'Continuous Insulation' shows a uniform layer of insulation (indicated by blue and green arrows) that prevents heat from escaping through the studs.



Kingspan, youtube.com

16



SIMPLE MATH?

WHY AN R-25 WALL IS NOT EQUAL TO AN R-20+ 5CI?

- Energy code math is no different than any other math, i.e., 1+1=2 still holds true
- **Units must agree** – 1 apple + 2 oranges ≠ 3 oranges; adding up R-Values for insulation located in different parts of a wall does not work either:
 - Cavity insulation is *interrupted* by framing - allows heat through more readily
 - Continuous insulation is *uninterrupted* – framing (heat) losses are minimized
 - Layer of Cavity insulation w/ same R value is less effective than a layer of the same R value of Continuous Insulation
- Method for calculating requires the *Parallel Path*
 - Determine R-Value for each different path, i.e., through two or more paths: cavity insulation, framing, fenestrations
 - Include all material and properties, i.e. *air films, cladding, sheathing, drywall*
 - Combine the total of the two paths to get overall R-Value of entire wall assembly
 - Totals = the sum of R-Values for each layer in each path



17



PARALLEL PATH EXAMPLES (Wood Framed Walls)

EXAMPLE :
R25 (cavity) + R0 (ci) wall: and R20 + 5 (ci) wall

Layer	R25 + 0ci Wall		R20 + 5ci Wall	
	Framing Path	Cavity Path	Framing Path	Cavity Path
Outside Air Film	R-0.17	R-0.17	R-0.17	R-0.17
Siding	R-0.62	R-0.62	R-0.62	R-0.62
Continuous Insulation---	---	---	R-5	R-5
7/16" OSB	R-0.62	R-0.62	R-0.62	R-0.62
SPF 2x6 Stud	R-6.875	---	R-6.875	---
Cavity Insulation	---	R-25	---	R-20
½" Drywall	R-0.45	R-0.45	R-0.45	R-0.45
Inside Air Film	R-0.68	R-0.68	R-0.68	R-0.68
Total	R-9.415	R-27.54	R-14.415	R-27.54

Same R-Value though R20 +5ci
is **12% greater in thermal resistance** than R25 +0
ci



1.Crandell, J. & Ahrenholz, T. Foam Plastics Applications for Better Living, "Energy Code Math Lesson: Why an R-25 Wall is Not Equal to a R-20+5ci", August 7, 2017
2.Miles, J. Miles & Associates Inc., "Calculate the R Value of a wall assembly", Nov. 8, 2012

NEXT STEPS and ASSUMPTIONS

- Combine the two parallel paths for overall value
- Assume 25% Framing Factor (*ff*) = 21% studs, 4% headers
 - 75% cavity area – typical for 16" o.c. framing
- Calculate the U-Factor:

$$U = ff_{framing} * \frac{1}{R_{framing}} + ff_{cavity} * \frac{1}{R_{cavity}}$$

R25 Cavity + 0 ci wall

$$U = .25 * 1 / 9.45 + .75 * 1 / 27.54 = .25 * .1058 + .75 * .036 =$$

Effective U Factor = 0.02645 + 0.027 = 0.05345

R = 18.7


R20 Cavity + 5 ci wall

$$U = .25 * 1 / 14.45 + .75 * 1 / 27.54 = .25 * .0173 + .75 * .036 =$$

Effective U Factor = 0.0173 + 0.0272 = 0.0443

R = 22.57

18



PRESCRIPTIVE CONTINUOUS INSULATION APPLICATION REQUIREMENTS

2021 WSEC-R:

- Wood Frame Wall R-Value – 20+5 or 13+10
- Vapor Retarder – **R402.1.1 0** – references R702.7 of IRC or 1404.3 of IBC

2021 Washington State Residential Code:


- Table R702.7(4) Continuous Insulation with Class II Vapor Retarder

CLIMATE ZONE	CLASS II VAPOR RETARDERS PERMITTED FOR: ^a
4, 5 and 6	Continuous insulation with <i>R</i> -value ≥ 3 over 2 × 4 wall. Continuous insulation with <i>R</i> -value ≥ 5 over 2 × 6 wall.

a. The requirements in this table apply only to insulation used to control moisture in order to permit the use of Class II vapor retarders. The insulation materials used to satisfy this option also contribute to but do not supersede the thermal envelope requirements of Chapter 11.

Exception:

- unheated accessory structures
- unheated storage rooms ≤ 70 S.F. and carports



19




TABLE R702.7 VAPOR RETARDERS – 2021 WASHINGTON STATE RESIDENTIAL CODE

CLIMATE ZONE	CLASS II VAPOR RETARDERS PERMITTED FOR: ^{a, b}
Marine 4, 5 and 6	Vented cladding over wood structural panels. Vented cladding over fiberboard. Vented cladding over gypsum. Continuous insulation with <i>R</i> -value ≥ 3.0 over 2 × 4 wall. Continuous insulation with <i>R</i> -value ≥ 5.0 over 2 × 6 wall.

a. The requirements in this table apply only to insulation used to control moisture in order to permit the use of Class II vapor retarders. The insulation materials used to satisfy this option also contribute to but do not supersede the thermal envelope requirements of Chapter 11.


TABLE R702.7(4) CONTINUOUS INSULATION W/ CLASS III VAPOR RETARDERS PERMITTED

CLIMATE ZONE	VAPOR RETARDER CLASS		
	CLASS I ^a	CLASS II ^a	CLASS III
1, 2	Not Permitted	Not Permitted	Permitted
3, 4 (except Marine 4)	Not Permitted	Permitted ^c	Permitted
	Marine 4, 5, 6, 7, 8	Permitted ^b	Permitted ^c See Table R702.7

a. Class I and II vapor retarders with vapor permeance greater than 1 perm when measured by ASTM E96 water method (Procedure B) shall be allowed on the interior side of any frame wall in all climate zones.

b. Use of a Class I interior vapor retarder in frame walls with a Class I vapor retarder on the exterior side shall require an approved design.

c. Where a Class II vapor retarder is used in combination with foam plastic insulating sheathing installed as continuous insulation on the exterior side of frame walls, the continuous insulation shall comply with Table R702.7(4) and the Class II vapor retarder shall have a vapor permeance greater than 1 perm when measured by ASTM E96 water method (Procedure B).



20



2021 WASHINGTON STATE RESIDENTIAL CODE

SECTION R703.1, R703.1.1 EXTERIOR COVERING

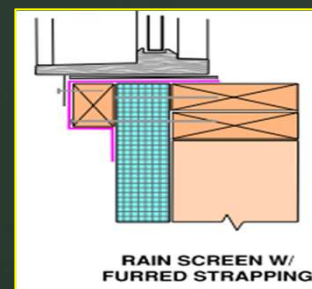
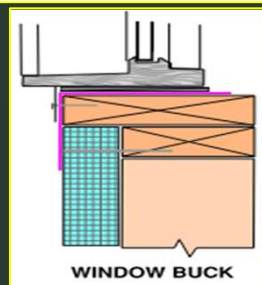
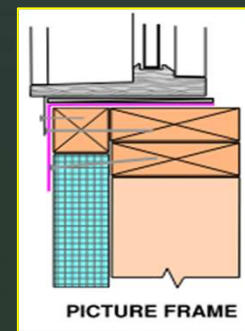
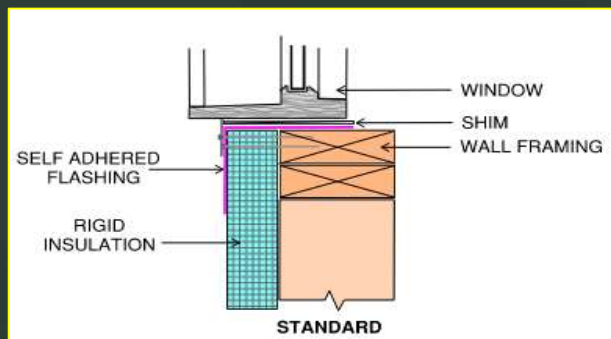
- Exterior walls shall provide the building with a weather-resistant exterior wall envelope.
- Exception: Log walls designed and constructed in accordance with the provisions of [ICC 400](#).
- Designed and constructed in a manner that prevents the accumulation of water within the wall assembly providing a water-resistant barrier behind the exterior veneer as required by Section R703.2 and a means of draining to the exterior water that enters the assembly to the exterior.
- EXCEPTIONS:
 - not be required over concrete or masonry walls
 - not be required for an exterior wall envelope that has been demonstrated to resist wind-driven rain through testing



21

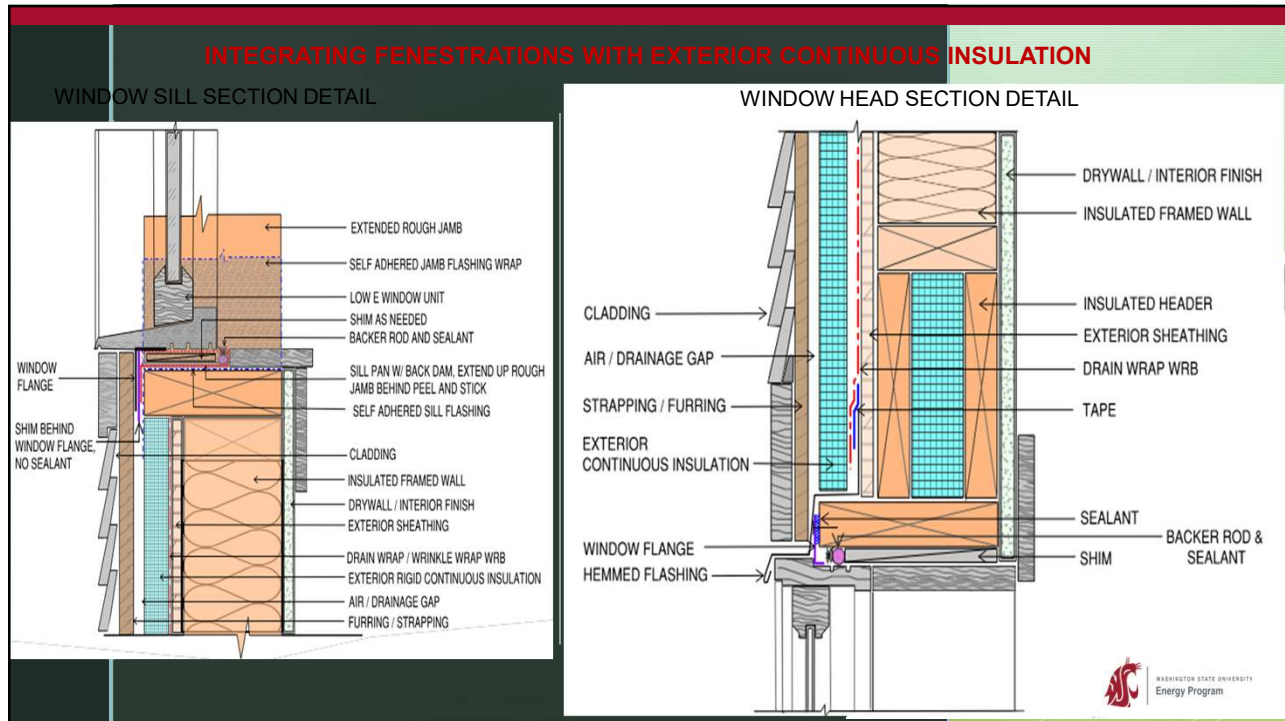


FOUR TYPICAL METHODS FOR WINDOW FRAMING WITH RIGID INSULATION

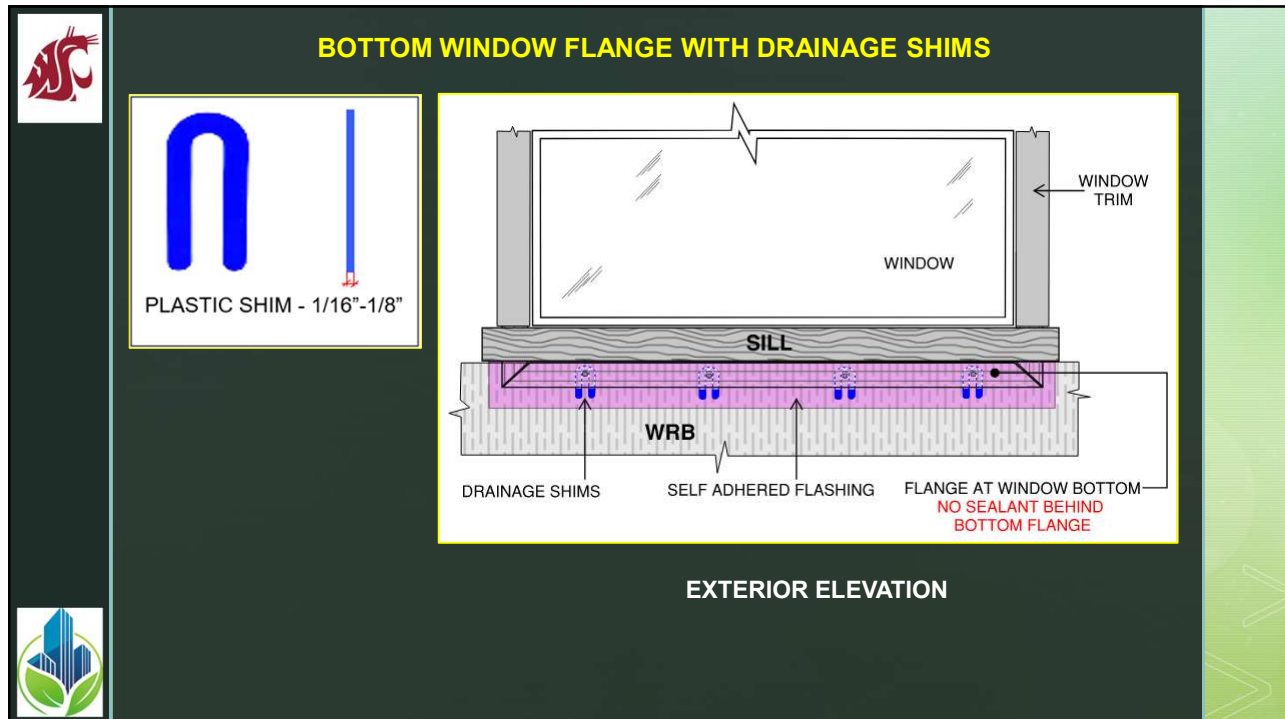


Adopted from ContinuousInsulation.org, Applied Building Technology Group, LLC, 6/30/2021


22



23



24



On this date 3-27:


- In 1513, Spanish explorer Juan Ponce de Leon sighted present-day Florida.
 - 1914 – The first successful blood transfusion is performed
- 1994 an outbreak of killer tornadoes raced east-northeastward across the southeast U.S. mainly from north-central Alabama and northern Georgia to the Carolinas
- 1939 The first-ever NCAA Men's Division I Basketball Tournament ended with Oregon defeating Ohio State 46-33 in the Final.

Multifamily Mash-Up

R406.2 & R406.3 + Mechanicals

This presentation's purpose is to guide the perspective viewer through a summary review of the WSEC-R and how it is utilized in multifamily permitting for Washington State. This education is a shared event with Jonathan's portion being an estimated 2 hours.

1. Rick Blumenthal's Journey through the building envelope.
2. Energy Credit's and Required Commissioning
3. Ventilation (Energy Code, IRC, IMC)
4. Conclusion & Questions



25





Table R406.2 ENERGY EQUALIZATION CREDITS <i>Multifamily Homes</i>				
Heating Options	Description of Primary Heating Source	Supplemental Heating	2018	2021
1	For combustion heating equipment meeting minimum federal efficiency standards for the equipment listed in Table C403.3.2(5) or C403.3.2(6)	Yes	0	0
2	For an initial heating system using a heat pump that meets federal standards for the equipment listed in Table C403.3.2(2) and supplemental heating provided by electric resistance or a combustion furnace meeting minimum standards listed in Table C403.3.2(5)b found in the 2021 WSEC-COMMERCIAL ENERGY CODE	See footnote b	1.0	0
3	For heating system based on electric resistance only (either forced air or Zonal)	N/A	-1.0	-0.5
4 ^c	For heating system using a heat pump that meets federal standards for the equipment listed in Table C403.3.2(2) or C403.3.2(9) or Air to water heat pump units that are configured to provide both heating and cooling and are rated in accordance with AHRI 550/590	See Manual Design & See footnote c	New	2.0
5	For heating system based on electric resistance with: 1. Inverter-driven ductless mini-split heat pump system installed in the largest zone in the dwelling, or 2. With 2kW or less total installed heating capacity per dwelling	See footnote c	0	0

a See Section R401.1 and residential building in Section R202 for Group R-2 scope.

b The gas back-up furnace will operate as fan-only when the heat pump is operating. The heat pump shall operate at all temperatures above 38°F (3.3°C) (or lower). Below that "changeover" temperature, the heat pump would not operate to provide space heating. The gas furnace provides heating below 38°F (3.3°C) (or lower).

c Additional points for this HVAC system are included in Table R406.3

Dwelling units serving **Group R-2** occupancies: (4-5) **6.5 credits**
 See Section R401.1 and residential building in Section R202 for Group R-2 scope.





26


TABLE R406.3 ENERGY CREDITS			
OPTION	DESCRIPTION	CREDIT(S)	
		All Other	Group R-2 ^b
1. EFFICIENT BUILDING ENVELOPE OPTIONS			
Only one option from Items 1.1 through 1.4 may be selected in this category. Compliance with the conductive UA targets is demonstrated using Section R402.1.5. Total UA alternative, where $[1 - (\text{Proposed UA} / \text{Target UA})] > \text{the required \%UA reduction}$			
1.1	Prescriptive compliance is based on Table R402.1.3 with the following modifications: Vertical fenestration U = 0.22.	N/A	0.5
1.2	Prescriptive compliance is based on Table R402.1.3 with the following modifications: Vertical fenestration U = 0.25 Floor R-38 Slab on grade R-10 perimeter and under entire slab Below grade slab R-10 perimeter and under entire slab or Compliance based on Section R402.1.5: Reduce the Total conductive UA by 15%.	N/A	1.0
1.3	Prescriptive compliance is based on Table R402.1.3 with the following modifications: Vertical fenestration U = 0.18 Ceiling and single-rafter or joist-vaulted R-60 advanced Wood frame wall R-21 int plus R-12 ci Floor R-38 Basement wall R-21 int plus R-12 ci Slab on grade R-10 perimeter and under entire slab Below grade slab R-10 perimeter and under entire slab or Compliance based on Section R402.1.5: Reduce the Total conductive UA by 22.5%.	N/A	0.5
1.4	Prescriptive compliance is based on Table R402.1.3 with the following modifications: Vertical fenestration U = 0.18 Ceiling and single-rafter or joist-vaulted R-60 advanced Wood frame wall R-21 int plus R-16 ci Floor R-48 Basement wall R-21 int plus R-16 ci Slab on grade R-20 perimeter and under entire slab Below grade slab R-20 perimeter and under entire slab or Compliance based on Section R402.1.5: Reduce the Total conductive UA by 30%.	N/A	2.0

Multifamily Credits

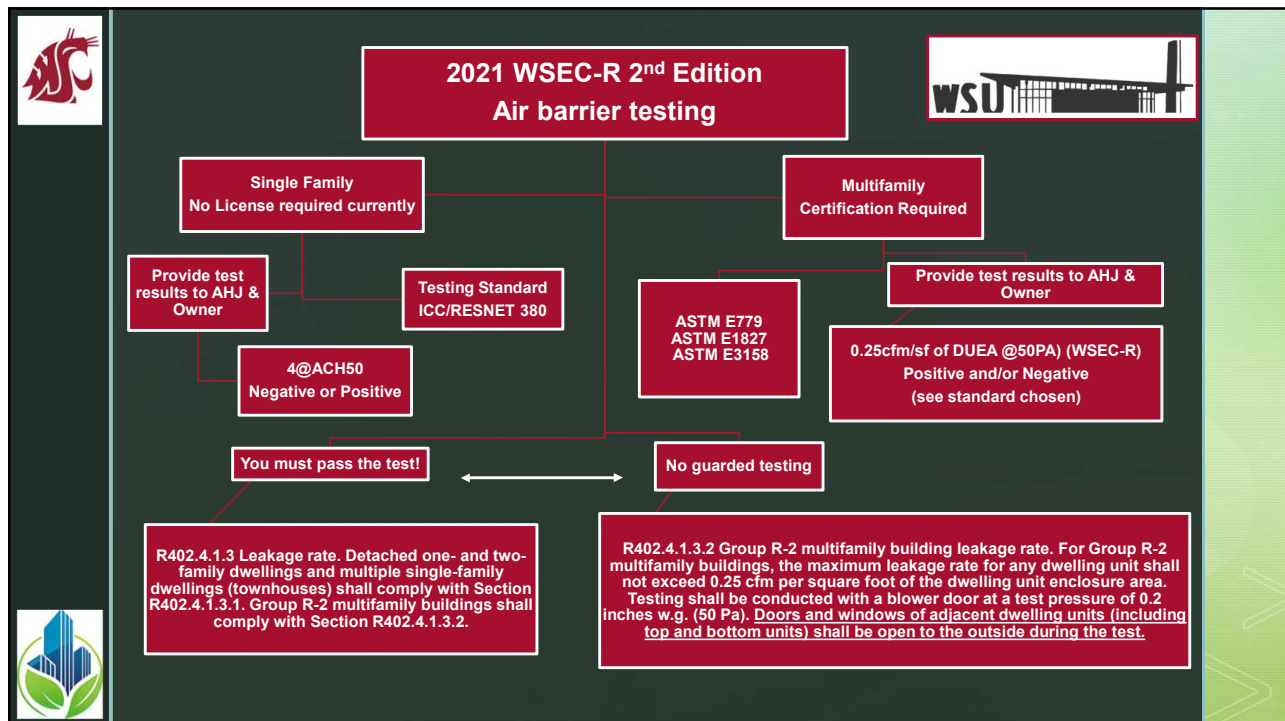
2. AIR LEAKAGE CONTROL AND EFFICIENT VENTILATION OPTIONS		MF
Only one option from Items 2.1 through 2.3 may be selected in this category.		
2.1	Compliance based on Section R402.4.1.2: Reduce the tested air leakage to 2.0 air changes per hour maximum at 50 Pascals or For R-2 Occupancies, optional compliance based on Section R402.4.1.2: Reduce the tested air leakage to 0.25 cfm/ft ² maximum at 50 Pascals and All whole house ventilation requirements as determined by Section M1505.3 of the <i>International Residential Code</i> or Section 403.8 of the <i>International Mechanical Code</i> shall be met with a heat recovery ventilation system with minimum sensible heat recovery efficiency of 0.65. To qualify to claim this credit, the building permit drawings shall specify the option being selected and shall specify the maximum tested building air leakage and shall show the heat recovery ventilation system.	1.0
2.2	Compliance based on Section R402.4.1.2: Reduce the tested air leakage to 1.5 air changes per hour maximum at 50 Pascals or For R-2 Occupancies, optional compliance based on Section R402.4.1.2: Reduce the tested air leakage to 0.20 cfm/ft ² maximum at 50 Pascals and All whole house ventilation requirements as determined by Section M1505.3 of the <i>International Residential Code</i> or Section 403.8 of the <i>International Mechanical Code</i> shall be met with a heat recovery ventilation system with minimum sensible heat recovery efficiency of 0.75. To qualify to claim this credit, the building permit drawings shall specify the option being selected and shall specify the maximum tested building air leakage and shall show the heat recovery ventilation system.	1.5
2.3	Compliance based on Section R402.4.1.2: Reduce the tested air leakage to 0.6 air changes per hour maximum at 50 Pascals or For R-2 Occupancies, optional compliance based on Section R402.4.1.2: Reduce the tested air leakage to 0.15 cfm/ft ² maximum at 50 Pascals and All whole house ventilation requirements as determined by Section M1505.3 of the <i>International Residential Code</i> or Section 403.8 of the <i>International Mechanical Code</i> shall be met with a heat recovery ventilation system with minimum sensible heat recovery efficiency of 0.80. Duct installation shall comply with Section (R402.4.7) R403.3.2. To qualify to claim this credit, the building permit drawings shall specify the option being selected and shall specify the maximum tested building air leakage and shall show the heat recovery ventilation system.	2.0


OPTION	DESCRIPTION
2. AIR LEAKAGE CONTROL AND EFFICIENT VENTILATION OPTIONS Only one option from Items 2.1 through 2.3 may be selected in this category.	
2.1	<p>Compliance based on Section R402.4.1.2: Reduce the tested air leakage to 2.0 air changes per hour maximum at 50 Pascals</p> <p>or</p> <p>For R-2 Occupancies, optional compliance based on Section R402.4.1.2: Reduce the tested air leakage to 0.25 cfm/ft² maximum at 50 Pascals</p> <p>and</p> <p>All whole house ventilation requirements as determined by Section M1505.3 of the <i>International Residential Code</i> or Section 403.8 of the <i>International Mechanical Code</i> shall be met with a heat recovery ventilation system with minimum sensible heat recovery efficiency of 0.65.</p> <p>To qualify to claim this credit, the building permit drawings shall specify the option being selected and shall specify the maximum tested building air leakage and shall show the heat recovery ventilation system.</p>



29





30

Energy credit option	New HSPF 2	Old HSPF
3.2 & 3.3 ducted central heat pump	8.1	9.5
3.5 ductless heat pump in main living area + electric resistance in other rooms	9	10
3.6 ducted central heat pump	9.4	11
3.6 ducted central heat pump – NEEP cc VCHP list	8.5	10
3.7 ductless heat pump with no electric resistance (except footnote A)	9	10
3.7 ductless heat pump with no electric resistance ≤ 24,000 Btu (except footnote A)	8.1	9

33

3.3 ^{a,c,d}	<p>Air-source, centrally ducted heat pump with minimum HSPF 2 of 8.1 (HSPF of 9.5).</p> <p>In areas where the winter design temperature as specified in Appendix RC is 23°F or below, a cold climate heat pump found on the NEEP cc ASHP qualified product list shall be used.</p> <p>To qualify to claim this credit, the building permit drawings shall specify the option being selected and shall specify the heating equipment type and the minimum equipment efficiency.</p>	N/A	NA
3.4 ^{a,d}	<p>Closed-loop ground source heat pump; with a minimum COP of 3.3 or</p> <p>Open loop water source heat pump with a maximum pumping hydraulic head of 150 feet and minimum COP of 3.6.</p> <p>To qualify to claim this credit, the building permit drawings shall specify the option being selected and shall specify the heating equipment type and the minimum equipment efficiency.</p>	N/A	1.0
3.5 ^d	<p>Ductless mini-split heat pump system, zonal control: In homes where the primary space heating system is zonal electric heating, a ductless mini-split heat pump system with a minimum HSPF 2 of 9 (HSPF of 10.0) shall be installed and provide heating to the largest zone of the housing unit.</p> <p>To qualify to claim this credit, the building permit drawings shall specify the option being selected and shall specify the heating equipment type and the minimum equipment efficiency.</p>	N/A	2.0
3.6 ^a	<p>Air-source, centrally ducted heat pump with minimum HSPF 2 of 9.4 (HSPF of 11.0).</p> <p>A centrally ducted air source cold climate variable capacity heat pump (cc VCHP) found on the NEEP cc VCHP qualified product list with a minimum of 9 HSPF 2 (10 HSPF) may be used to satisfy this requirement.</p> <p>In areas where the winter design temperature as specified in Appendix RC is 23°F or below, an air source centrally ducted heat pump shall be a cold climate variable capacity heat pump as listed on the NEEP qualified product list.</p> <p>To qualify to claim this credit, the building permit drawings shall specify the option being selected and shall specify the heating equipment type and the minimum equipment efficiency.</p>	N/A	N/A

34

	3.7 ^{a,d,e}	<p>Ductless split system heat pumps with no electric resistance heating in the primary living areas. A ductless heat pump system with a minimum HSPF 2 of 9 (HSPF of 10) shall be sized and installed to provide heat to entire dwelling unit at the design outdoor air temperature.</p> <p>Exception: In homes with total heating loads of 24,000 or less using multi-zone mini-split systems with nominal ratings of 24,000 or less, the minimum HSPF s to claim this credit shall be 8.19 HSPF 2 (or 9 HSPF).</p> <p>To qualify to claim this credit, the building permit drawings shall specify the option being selected, the heated floor area calculation, the heating equipment type(s), the minimum equipment efficiency, and total installed heat capacity (by equipment type).</p>	N/A	3.0
	3.8 ^{a,d}	<p>Air-to-water heat pump with minimum COP of 3.2 at 47°F, rated in accordance with AHRI 550/590 by an accredited or certified testing lab.</p> <p>To qualify to claim this credit, the building permit drawings shall specify the option being selected, the heated floor area calculation, the heating equipment type(s), the minimum equipment efficiency, and total installed heat capacity (by equipment type).</p>	N/A	NA
	3.9	<p>Gas-fired heat pump(s) meeting ANSI Z21.40.2 and Z21.40.4 or CSA, with a minimum UEF of 1.15.</p> <p>For R-2 Occupancy, gas-fired heat pump(s) meeting ANSI Z21.40.2 and Z21.40.4 or CSA, with a minimum UEF of 1.15, shall serve all units.</p>	N/A	1.5



35

OPTION	DESCRIPTION	CREDIT(S)	
		All Other	Group R-2 ^b
3.10 ^f	<p>Combination water heating and space heating system shall include one of the following: Gas-fired heat pump water heater(s) meeting Tier 2 of the NEEA Advanced Water Heating Specification for Gas-Fueled Residential Storage Water Heaters Version 1.0.</p> <p>or</p> <p>For R-2 Occupancy, gas-fired heat pump water heater(s) meeting Tier 2 of the NEEA Advanced Water Heating Specification for Gas-Fueled Residential Storage Water Heaters Version 1.0., shall serve all units.</p> <p>or</p> <p>For R-2 Occupancy, gas-fired heat pump(s) meeting ANSI Z21.40.2 and Z21.40.4 or CSA, with a minimum UEF of 1.15, shall serve all units. To qualify to claim this credit, the building permit drawings shall specify the option being selected and shall specify the water heater equipment type and the minimum equipment efficiency and, for solar water heating systems, the calculation of the minimum energy savings.</p>	N/A	2.5
3.11 ^e	<p>Connected thermostat meeting ENERGY STAR Certified Smart Thermostats/EPA ENERGY STAR specifications.</p> <p>To qualify to claim this credit, the building permit drawings shall specify the option being selected and shall specify the thermostat model.</p>	N/A	0.5

Couples with Option 1

1 For combustion heating equipment meeting minimum federal efficiency standards for the equipment listed in Table C403.3.2(5) or C403.3.2(6)

36

Energy Equalization Option 1
HVAC Selection Available

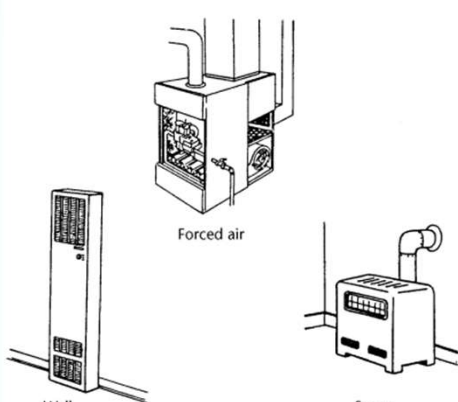
3.1

3.9

3.10

Possible
3.11



Combustion Heating Systems



Forced air

Wall
Space

37

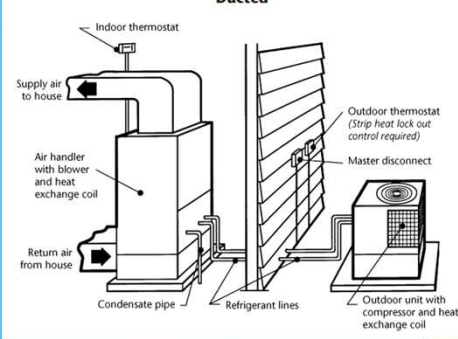
Energy Equalization Option 2
HVAC Selection Available

3.2

Possibly
3.11
Need Clarification on Errata.

Split Package Heat Pump Options Ducted

Figure 7-3



Indoor thermostat

Supply air to house

Air handler with blower and heat exchange coil

Return air from house

Condensate pipe


Refrigerant lines

Outdoor thermostat (Strip heat lock out control required)


Master disconnect

Outdoor unit with compressor and heat exchange coil

38

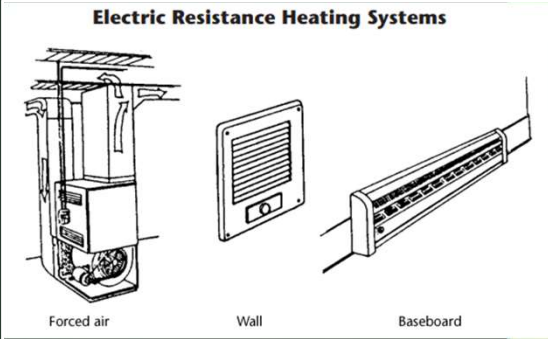


**Energy Equalization Option 3
HVAC Selection Available**




N/A

Electric Resistance Heating Systems




Forced air
Wall
Baseboard

39



**Energy Equalization Option 4
HVAC Selection Available**



3.3

3.4

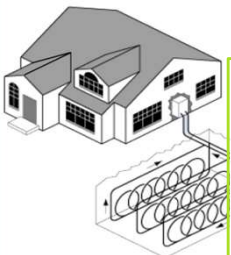
3.6

3.7

3.8

All other images are courtesy of the WSU Builder Field Guide.

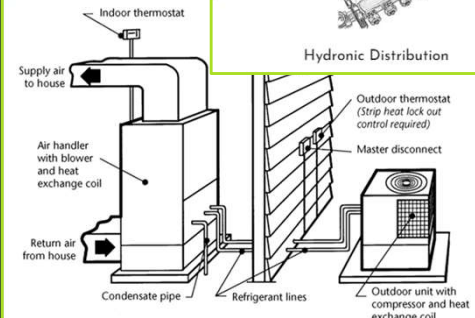
From EERE.ENERGY.GOV




Cold Climate Heating & Cooling Heat Pump

Source: Arctic Heat Pumps


Hydronic Distribution



40





**Energy Equalization Option 5
HVAC Selection Available**



3.5


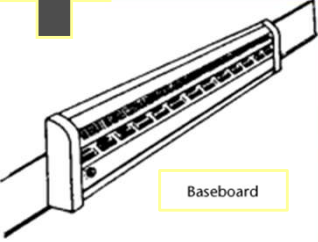
Ductless

Air handler with blower and heat exchange coil

Outdoor unit with compressor and heat exchange coil


+


Wall


Baseboard

41




**Energy Equalization Option 5
HVAC Selection Available**





R403.3.5 Duct Testing

- Ducts shall be leak tested in accordance with WSU RS-33, using the maximum duct leakage rates specified.
- **EXCEPTION:** A duct air leakage test shall not be required for ducts serving ventilation systems that are not integrated with the ducts serving heating or cooling systems.
- A written report of the results shall be signed by the party conducting the test and provided to the code official.




R403.3.6 Duct leakage.

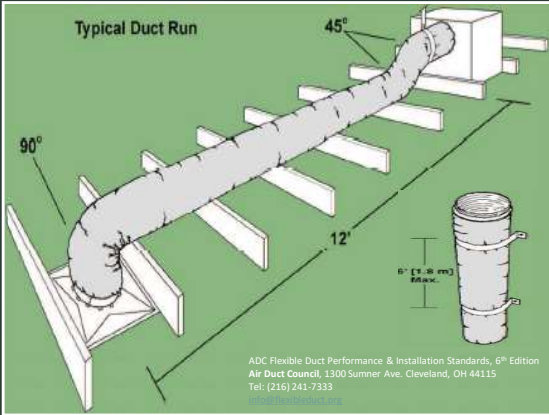
The total leakage of the ducts, where measured in accordance with Section R403.3.3, shall be as follows:

- Test for ducts within thermal envelope: Where all ducts and air handlers are located entirely within the building thermal envelope, total leakage shall be less than or equal to 8.0 cubic feet per minute (226.6 L/min) per 100 square feet (9.29 m²) of conditioned floor area. For forced air ducts, a maximum of 10 linear feet of return ducts and 5 linear feet of supply ducts may be located outside the conditioned space. All metallic ducts located outside the conditioned space must have both transverse and longitudinal joints sealed with mastic. If flex ducts are used, they cannot contain splices. Flex duct connections must be made with nylon straps and installed using a plastic strapping tensioning tool. Ducts located in crawl spaces do not qualify for this exception.

42



Flex Duct Length, Bends, and Vertical Application




ADC Flexible Duct Performance & Installation Standards, 6th Edition
Air Duct Council, 1300 Summer Ave. Cleveland, OH 44115
Tel: (216) 241-7333

Entrance Fitting	35ft
Total Duct Length	14ft
2 x 45° Bends (2x10')	20ft
1 x 90° Bend (1x20')	20ft
Exit Fitting	35ft
Total Effective Length	124ft


The distance from the plenum to the terminal end in this example is approximates 12ft, the total equivalent is 124ft.

The equivalent length values for bends & fittings represented above are default values from the ACCA Manual D and based on 900fpm at 0.08 IWC/100ft for supply ducts and 700fpm at the 0.08 IWC/100ft of return ducts.

43



Ventilation will have an effect on the dwellings comfort and the homes energy use!



ACCA Manual Types J, S, D, & T:

As you can see there is a lot to the design and implementation of an HVAC system. All homes are required to provide a Manual J and provide the equipment selected to meet the Manual J.

This is the bare bones minimum the code requires. As you can see by the chart on my right that there is a lot more to good system HVAC design, installation and commissioning.

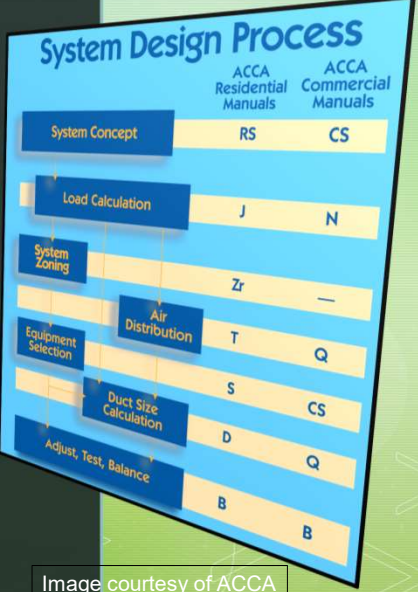


Image courtesy of ACCA



44

5. EFFICIENT WATER HEATING OPTIONS			
Only one option from Items 5.3 through 5.8 may be selected in this category. Items 5.1 and 5.2 may be combined with any option.			
OPTION	DESCRIPTION	CREDIT(S)	
		All Other	Group R-2 ^b
5.1	<p>A drain water heat recovery unit(s) shall be installed, which captures wastewater heat from at least two showers, including tub/shower combinations. It is acceptable, but not required, for sink water to be connected. Unit shall have a minimum efficiency of 40% if installed for equal flow or a minimum efficiency of 54% if installed for unequal flow. Such units shall be rated in accordance with CSA B55.1 or IAPMO IGC 346-2017 and be so labeled.</p> <p>To qualify to claim this credit, the building permit drawings shall include a plumbing diagram that specifies the drain water heat recovery units and the plumbing layout needed to install it. Labels or other documentation shall be provided that demonstrates that the unit complies with the standard.</p>	N/A	0.5
5.2	<p>For Compact Hot Water Distribution system credit, the volume shall store not more than 16 ounces of water between the nearest source of heated water and the termination of the fixture supply pipe where calculated using Section R403.5.2. <i>Construction documents</i> shall indicate the ounces of water in piping between the hot water source and the termination of the fixture supply. When the hot water source is the nearest primed plumbing loop or trunk, this must be primed with an On Demand recirculation pump and must run a dedicated ambient return line from the furthest fixture or end of loop to the water heater.</p> <p>To qualify for this credit, the dwelling must have a minimum of 1.5 bathrooms.</p>	N/A	0.5



45

5. EFFICIENT WATER HEATING OPTIONS			
Only one option from Items 5.3 through 5.8 may be selected in this category. Items 5.1 and 5.2 may be combined with any option.			
5.3	<p>Water heating system shall include the following: Energy Star rated gas or propane water heater with a minimum UEF of 0.80.</p> <p>To qualify to claim this credit, the building permit drawings shall specify the option being selected and shall specify the water heater equipment type and the minimum equipment efficiency.</p>	N/A	0.5
5.4	<p>Water heating system shall include one of the following: Energy Star rated gas or propane water heater with a minimum UEF of 0.91 or Solar water heating supplementing a minimum standard water heater. Solar water heating will provide a rated minimum savings of 85 therms or 2000 kWh based on the Solar Rating and Certification Corporation (SRCC) Annual Performance of OG-300 Certified Solar Water Heating System or Water heater heated by ground source heat pump meeting the requirements of Option 3.4.</p> <p>To qualify to claim this credit, the building permit drawings shall specify the option being selected and shall specify the water heater equipment type and the minimum equipment efficiency and, for solar water heating systems, the calculation of the minimum energy savings.</p>	N/A	1.0



46

	5. EFFICIENT WATER HEATING OPTIONS Only one option from Items 5.3 through 5.8 may be selected in this category. Items 5.1 and 5.2 may be combined with any option.		
	5.5	Water heating system shall include one of the following: Gas-fired heat pump water heater(s) meeting Tier 2 of the NEEA Advanced Water Heating Specification for Gas-Fueled Residential Storage Water Heaters Version 1.0. or For R-2 Occupancy, gas-fired heat pump water heater(s) meeting Tier 2 of the NEEA Advanced Water Heating Specification for Gas-Fueled Residential Storage Water Heaters Version 1.0. shall supply domestic hot water to all units. or For R-2 Occupancy, gas-fired heat pump water heater(s) meeting ANSI Z21.40.2 and Z21.40.4 or CSA, with a minimum UEF of 1.15, shall supply domestic hot water to all units. To qualify to claim this credit, the building permit drawings shall specify the option being selected and shall specify the water heater equipment type and the minimum equipment efficiency and, for solar water heating systems, the calculation of the minimum energy savings.	N/A
			



47

	5. EFFICIENT WATER HEATING OPTIONS Only one option from Items 5.3 through 5.8 may be selected in this category. Items 5.1 and 5.2 may be combined with any option.		
	5.6	Water heating system shall include one of the following: Electric heat pump water heater meeting the standards for Tier III of NEEA's advanced water heating specification or For R-2 Occupancy, electric heat pump water heater(s), meeting the standards for Tier III of NEEA's advanced water heating specification, shall supply domestic hot water to all units. If one water heater is serving more than one dwelling unit, all hot water supply and recirculation piping shall be insulated with R-8 minimum pipe insulation. To qualify to claim this credit, the building permit drawings shall specify the option being selected and shall specify the water heater equipment type and the minimum equipment efficiency.	N/A
			


48


	5. EFFICIENT WATER HEATING OPTIONS Only one option from Items 5.3 through 5.8 may be selected in this category. Items 5.1 and 5.2 may be combined with any option.	
	5.7 Water heating system shall include one of the following: Electric heat pump water heater with a minimum UEF of 2.9 and utilizing a split system configuration with the air-to-refrigerant heat exchanger located outdoors. Equipment shall meet Section 4, requirements for all units, of the NEEA standard <i>Advanced Water Heating Specification</i> with the UEF noted above or For R-2 Occupancy, electric heat pump water heater(s), meeting the standards for Tier III of NEEA's advanced water heating specification and utilizing a split system configuration with the air-to-refrigerant heat exchanger located outdoors, shall supply domestic hot water to all units. If one water heater is serving more than one dwelling unit, all hot water supply and recirculation piping shall be insulated with R-8 minimum pipe insulation. To qualify to claim this credit, the building permit drawings shall specify the option being selected and shall specify the water heater equipment type and the minimum equipment efficiency.	N/A
		

49


	5. EFFICIENT WATER HEATING OPTIONS Only one option from Items 5.3 through 5.8 may be selected in this category. Items 5.1 and 5.2 may be combined with any option.	
	1 For combustion heating equipment meeting minimum federal efficiency standards for the equipment listed in Table C403.3.2(5) or C403.3.2(6)	Couples with Option 1
5.8 Combination water heating and space heating system shall include one of the following: Gas-fired heat pump water heater(s) meeting Tier 2 of the NEEA Advanced Water Heating Specification for Gas-Fueled Residential Storage Water Heaters Version 1.0. or For R-2 Occupancy, gas-fired heat pump water heater(s) meeting Tier 2 of the NEEA Advanced Water Heating Specification for Gas-Fueled Residential Storage Water Heaters Version 1.0., shall supply all units. or For R-2 Occupancy, gas-fired heat pump(s) meeting ANSI Z21.40.2 and Z21.40.4 or CSA, with a minimum UEF of 1.15, shall supply all units. To qualify to claim this credit, the building permit drawings shall specify the option being selected and shall specify the water heater equipment type and the minimum equipment efficiency and, for solar water heating systems, the calculation of the minimum energy savings.	N/A	2.5
		

50






NREL's PVWatts[™] Calculator
Estimates the energy production of grid-connected photovoltaic (PV) energy systems throughout the world. It allows homeowners, small building owners, installers and manufacturers to easily develop estimates of the performance of potential PV installations.




<https://pvwatts.nrel.gov/>

6. RENEWABLE ELECTRIC ENERGY OPTION

6.1	<p>For each 600 kWh of electrical generation per housing unit provided annually by on-site wind or solar equipment a 0.5 credit shall be allowed, up to 4.5 credits. Generation shall be calculated as follows:</p> <p>For solar electrical systems, the design shall be demonstrated to meet this requirement using the National Renewable Energy Laboratory calculator PVWATTS or alternative approved by the code official. Documentation noting solar access shall be included on the plans.</p> <p>For wind generation projects designs shall document annual power generation based on the following factors:</p> <p style="padding-left: 20px;">The wind turbine power curve; average annual wind speed at the site; frequency distribution of the wind speed at the site and height of the tower.</p> <p>To qualify to claim this credit, the building permit drawings shall specify the option being selected and shall show the photovoltaic or wind turbine equipment type, provide documentation of solar and wind access, and include a calculation of the minimum annual energy power production.</p>	N/A	0.5 – 4.5
-----	---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------	-----	-----------




51




7. APPLIANCE PACKAGE OPTION

7.1	<p>All of the following appliances shall be new and installed in the dwelling unit and shall meet the following standards:</p> <ol style="list-style-type: none"> 1. Dishwasher, standard – Energy Star rated, Most Efficient 2021 or Dishwasher, compact – Energy Star rated (Version 6.0) 2. Refrigerator (if provided) – Energy Star rated (Version 5.1) 3. Washing machine (Residential) – Energy Star rated (Version 8.1) 4. Dryer – Energy Star rated, Most Efficient 2022 <p>To qualify to claim this credit, the building permit drawings shall specify the option being selected and shall show the appliance type and provide documentation of Energy Star compliance. At the time of inspection, all appliances shall be installed and connected to utilities. Dryer ducts and exterior dryer vent caps are not permitted to be installed in the <i>dwelling unit</i>.</p>	N/A	1.5
-----	---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------	-----	-----

- a. An alternative heating source sized at a maximum of 0.5 Watts/ft² (equivalent) of heated floor area or 500 Watts, whichever is bigger, may be installed in the dwelling unit.
- b. See Section R401.1 and *residential building* in Section R202 for Group R-2 scope.
- c. Option 3.11 can only be taken with Options 3.1 and 3.3. To qualify to claim Option 3.11 with 3.3, the system shall be a 1-2 speed heat pump system. Variable capacity heat pumps are ineligible from claiming this option.
- d. This option may only be claimed if serving System Type 4 or 5 from Table R406.2.
- e. Primary living areas include living, dining, kitchen, family rooms, and similar areas.
- f. Option 3.10 may one be taken with Efficient Water Heating Option 5.1 or 5.2. Equipment sizing for space heating shall be calculated as provided in Section R403.7 with increased capacity to provide a minimum of 75 percent of peak hot water demand or shall be sized in accordance with *approved* manufacturer's specifications or guidance. Supplementary heat for water heating shall be in accordance with Section R403.5.7.



52




✓ R406.2 & R406.3 Options revised to reflect changes in code

✓ Additions with 150 square feet or less of conditioned floor area are now exempt from obtaining additional energy efficiency credits (R406.2 & R406.3).


✓ Changes to required credit values (Section R406.3).

1. Efficient Building Envelope Options
 1. Four options within this category (down from seven options)
 2. Maximum 2.5 credits possible from this category (down from 3.0)
 3. One glazing only option (1.1), down from two (1.1 and 1.2)
2. Air Leakage and Efficient Ventilation Envelope Options
 1. Three options within this category (down from four options)
 2. Maximum 2.0 credits possible from this category (Remain the same)
 3. All options now require a heat recovery ventilation system
3. High Efficiency HVAC Equipment Options
 1. Eleven options within this category (up from six options)
 2. Maximum 2.5 credits possible from this category (up from 2.0)
4. High Efficiency HVAC Distribution Options
 1. One option within this category (down from two options)
 2. Maximum 0.5 credits possible from this category (down from 1.0)
5. Efficient Water Heating Options
 1. Seven options within this category (up from six options)
 2. Maximum 3.5 credits possible from this category (up from 3.0)
6. Renewable Electric Energy Option
 1. Clarification that half credits can be achieved, though kWh worth the same number of credits: For each 600 kWh of generation, 0.5 credits can be achieved
 2. Maximum 4.5 credits possible from this category (up from 3.0)
7. Appliance Package Option
 1. Dryer must now meet Energy Star "Most Efficient 2022" rating
 2. Maximum 0.5 credits possible from this category

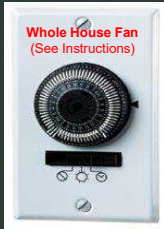
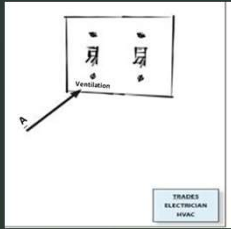
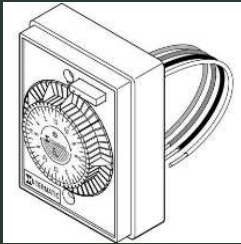
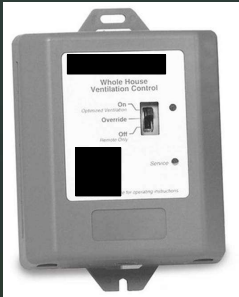
**Summary of Section R406
2021 WSEC –R 2nd Edition**



53

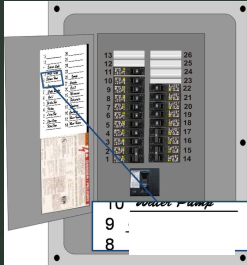



R403.6 Mechanical Ventilation.

R105.2.4 Mechanical rough-in inspection.

- HVAC type & size including controls, system insulation installation & R value, system leakage control, (sealing), programmable T-Stats, whole house ventilation & fan efficiency.
- Must have automatic controls with manual overrides, (automatic timer)
- Must be readily accessible
- Must provide operating instructions
- Must have label "whole house ventilation, see operating instructions"
- Operable air inlets may be used – required in each occupiable space
- Sone rating of 1.0 or less
- One dedicated fan may be used for whole house





54



**TABLE R403.6.1
WHOLE-DWELLING MECHANICAL VENTILATION SYSTEM FAN EFFICACY^a**

SYSTEM TYPE	AIR FLOW RATE (CFM)	MINIMUM EFFICACY (CFM/WATT)
HRV, ERV or balanced	Any	1.2 cfm/watt
Range hoods	Any	2.8 cfm/watt
In-line supply or exhaust fan	Any	3.8 cfm/watt
Other exhaust fan	<90	2.8 cfm/watt
	≥90	3.5 cfm/watt

For SI: 1 cfm = 28.3 L/min.

a. Design outdoor or exhaust airflow rate/watts of fan used.

WHOLE HOUSE

(Fan Location)	Air-Flow-Rate Minimum (cfm)	Minimum Efficacy (cfm/watt)	Air-Flow-Rate Maximum (cfm)
HRV-or-ERV	Any	1.2	Any
Range-hoods	Any	2.8	Any
In-line-fan	Any	3.8	Any
Bathroom; utility-room	40	1.4	<90
Bathroom; utility-room	90	2.8	Any



55



R403.6.1 Whole-House Mechanical Ventilation System Fan Efficacy.

- Fans shall be tested in accordance with HVI 916 and listed.
- The airflow shall be reported in the product listing or on the label. Fan efficacy shall be reported in the product listing or shall be derived from the input power and airflow values reported in the product listing on the label.
- Fan efficacy for fully ducted HRV, ERV, balanced, and in-line fans shall be determined at a static pressure of not less than 0.2 inch w.c. (49.85 Pa).
- Fan efficacy for ducted range hoods, bathroom and utility room fans shall be determined at a static pressure of not less than 0.1 inch w.c. (24.91 Pa).

R403.6.2 Testing.

Mechanical ventilation systems shall be tested and verified to provide the minimum ventilation flow rates required by Section R403.6. Testing shall be performed according to the ventilation equipment manufacturer's instructions, or by using a flow hood or box, flow grid, or other airflow measuring device at the mechanical ventilation fan's inlet terminals or grilles, outlet terminals or grilles, or in the connected ventilation ducts.


Where required by the code official, testing shall be conducted by an approved third party. A written report of the results of the test shall be signed by the party conducting the test and provided to the code official.

EXCEPTION:

Kitchen range hoods that are ducted to the outside with 6-inch (152 mm) or larger duct and not more than one 90-degree (1.57 rad) elbow or equivalent in the duct run.




56




M1505.4 Whole-house mechanical ventilation system.
 Each dwelling unit shall be equipped with a ventilation system. The whole-house mechanical ventilation systems shall be designed in accordance with Sections M1505.4.1 through M1505.4.4.

M1505.4.1 System design. This means balanced or supply only

The whole-house ventilation system shall consist of one or more supply fans, one or more exhaust fans, or an ERV/HRV with integral fans, associated ducts and controls. Whole-house mechanical ventilation system supply and exhaust fans shall meet the requirements of Sections M1505.4.1.2, M1505.4.1.3, M1505.4.1.4, and M1505.4.1.5. Local exhaust fans are permitted to serve as part of the whole-house ventilation system when provided with the proper controls in accordance with Section M1505.4.2. The systems shall be designed and installed to exhaust and/or supply the minimum outdoor airflow rates required by Section M1505.4.3 as modified by whole-house ventilation system coefficients in Section M1505.4.3.1 where applicable. The whole-house ventilation system shall operate continuously at the minimum ventilation rate required by Section M1505.4.2 unless configured with intermittent off controls in accordance with Section M1505.4.3.2.



57




M1505.4.1.1 Whole-house system component requirements.

Whole-house ventilation supply and exhaust fans specified in this section shall have a minimum efficacy as prescribed in the *Washington State Energy Code*. Design and installation of the system or equipment shall be carried out in accordance with manufacturers' installation instructions. Whole-house ventilation fans shall be rated for sound at no less than the minimum airflow rate required by Section M1505.4.3.1. Ventilation fans shall be rated for sound at a maximum of 1.0 sone. This sound rating shall be at a minimum of 0.1 in. w.c. (25 Pa) static pressure in accordance with HVI procedures specified in Sections M1505.4.1.2 and M1505.4.1.3.

Exception: HVAC air handlers, ERV/HRV units, and remote mounted fans need not meet the sound requirements. To be considered for this exception, a remote mounted fan must be mounted outside the habitable spaces, bathrooms, toilets, and hallways, and there must be at least 4 feet (1.3 m) of ductwork between the fan and the intake grille.

The whole-house supply fan shall provide ducted outdoor ventilation air to each habitable space within the residential unit. This means distributed

Exception: Interior joining spaces provided with a 30 cfm whole-house transfer fan or a permanent opening with an area of not less than 8 percent of the floor area of the interior adjoining space but not less than 25 square feet (2.3 m²) do not require ducted outdoor ventilation air to be supplied directly to the space. Whole-house transfer fans shall meet the sone rating of Section M1505.4.1.1 and shall have whole-house ventilation controls that comply with Section M1505.4.2.



58



M1505.4.1.2 Exhaust fans.

Exhaust fans required shall be ducted directly to the outside. Exhaust air outlets shall be designed to limit the pressure difference to the outside and equipped with backdraft dampers or motorized dampers in accordance with the *Washington State Energy Code*. Exhaust fans shall be tested and rated in accordance with the airflow and sound rating procedures of the Home Ventilating Institute (HVI 915, *HVI Loudness Testing and Rating Procedure*, HVI 916, *HVI Airflow Test Procedure*, and HVI 920, *HVI Product Performance Certification Procedure*, as applicable). Exhaust fans required in this section may be used to provide local ventilation. Bathroom exhaust fans that are designed for intermittent exhaust airflow rates higher than the continuous exhaust airflow rates in Table M1505.4.3.2 shall be provided with occupancy sensors or humidity sensors to automatically override the fan to the high speed airflow rate. The exhaust fans shall be tested and the testing results shall be submitted and posted in accordance with Section M1505.4.1.6.

M1505.4.1.3 Supply fans.

Supply fans used in meeting the requirements of this section shall supply outdoor air from intake openings in accordance with *International Mechanical Code* Sections 401.4 and 401.5. When designed for intermittent off operation, supply systems shall be equipped with motorized dampers in accordance with the *Washington State Energy Code*. Supply fans shall be tested and rated in accordance with the airflow and sound rating procedures of the Home Ventilating Institute (HVI 915, *HVI Loudness Testing and Rating Procedure*, HVI 916, *HVI Airflow Test Procedure*, and HVI 920, *HVI Product Performance Certification Procedure*, as applicable). Where outdoor air is provided by supply fan systems the outdoor air shall be filtered. The filter shall be accessible for regular maintenance and replacement. The filter shall have a Minimum Efficiency Rating Value (MERV) of at least 8.

59



M1505.4.1.4 Balanced whole-house ventilation system.

A balanced whole-house ventilation system shall include both supply and exhaust fans. The supply and exhaust fans shall have airflow that is within 10 percent of each other. The tested and balanced total mechanical exhaust airflow rate is within 10 percent or 5 cfm, whichever is greater, of the total mechanical supply airflow rate. The flow rate test results shall be submitted and posted in accordance with Section M1505.4.1.7. The exhaust fan shall meet the requirements of Section M1505.4.1.2. The supply fan shall meet the requirements of Section M1505.4.1.3. Balanced ventilation systems with both supply and exhaust fans in a packaged product, such as an ERV/HRV shall meet the requirements of HVI 920, as applicable. Local exhaust systems that are not a component of the whole-house mechanical ventilation system are exempt from the balanced airflow calculation.



M1505.4.1.5 Furnace integrated supply.

Systems using space heating and/or cooling air handler fans for outdoor air supply distribution are not permitted.

Exception: Air handler fans shall have multi-speed or variable speed supply airflow control capability with a low speed operation not greater than 25 percent of the rated supply airflow capacity during ventilation only operation. Outdoor air intake openings must meet the provisions of Sections R303.5 and R303.6 and must include a motorized damper that is activated by the whole-house ventilation system controller. The motorized damper must be controlled to maintain the outdoor airflow intake airflow within 10 percent of the whole-house mechanical exhaust airflow rate. The flow rate for the outdoor air intake must be tested and verified at the minimum ventilation fan speed and the maximum heating or cooling fan speed. The results of the test shall be submitted and posted in accordance with Section M1505.4.1.7.

60





M1505.4.1.6 Testing.

Whole-house mechanical ventilation systems shall be tested, **balanced** and verified to provide a flow rate not less than the minimum required by Sections M1505.4.3 and M1505.4.4.1. Testing shall be performed according to the ventilation equipment manufacturer's instructions, or by using a flow hood, flow grid, or other airflow measuring device at the mechanical ventilation fan's inlet terminals, outlet terminals or grilles or in the connected ventilation ducts. Where required by the building official, testing shall be conducted by an approved third party. A written report of the results of the test shall be signed by the party conducting the test and provided to the building official and be posted in the dwelling unit per Section M1505.4.1.7.


61

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	55
501-1,000	30	35	40	50	60
1,001-1,500	30	40	45	55	65
1,501-2,000	35	45	50	60	70
2,001-2,500	40	50	55	65	75
2,501-3,000	45	55	60	70	80
3,001-3,500	50	60	65	75	85
3,501-4,000	55	65	70	80	90
4,001-4,500	60	70	75	85	90
4,501-5,000	65	75	80	90	90

AREA TO BE EXHAUSTED	EXHAUST RATES
	Intermittent
Open Kitchens	In accordance with Section M1505.4.4.3
Enclosed Kitchens	In accordance with Section M1505.4.4.3
Bathrooms - Toilet rooms	50 cfm

62



CHAPTER 15 EXHAUST SYSTEMS

M1505.4.3 Mechanical ventilation rate.
 The whole-house mechanical ventilation system shall provide outdoor air at a continuous rate as determined in accordance with Table M1505.4.3(1) or Equation 15-1.

†Ventilation rate in cubic feet per minute = (0.01 × total square foot area of house) ÷ (7.5 × (number of bedrooms + 1))
 but not less than 30 cfm for each dwelling unit

**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
< 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 (CSYSTEM)**

SYSTEM TYPE	DISTRIBUTED	NOT DISTRIBUTED
Balanced	1.0	1.25
Not Balanced	1.25	1.5

M1505.4.3.1 Ventilation quality adjustment.
 The minimum whole-house ventilation rate from Section 1505.4.3 shall be adjusted by the system coefficient in Table M1505.4.3(2) based on the system type not meeting the definition of a balanced whole-house ventilation system and/or not meeting the definition of a distributed whole-house ventilation system.

$Q_v = Q_v \times C_{system}$ (Equation 15-2)

Where:
 Q_v = Quality-adjusted ventilation airflow rate in cubic feet per minute (cfm) (m³/s).
 Q_v = Ventilation airflow rate, cubic feet per minute (cfm) (m³/s) from 15-1 or Table M1505.4.3(1).
 C_{system} = System coefficient from Table 1505.4.3(2).

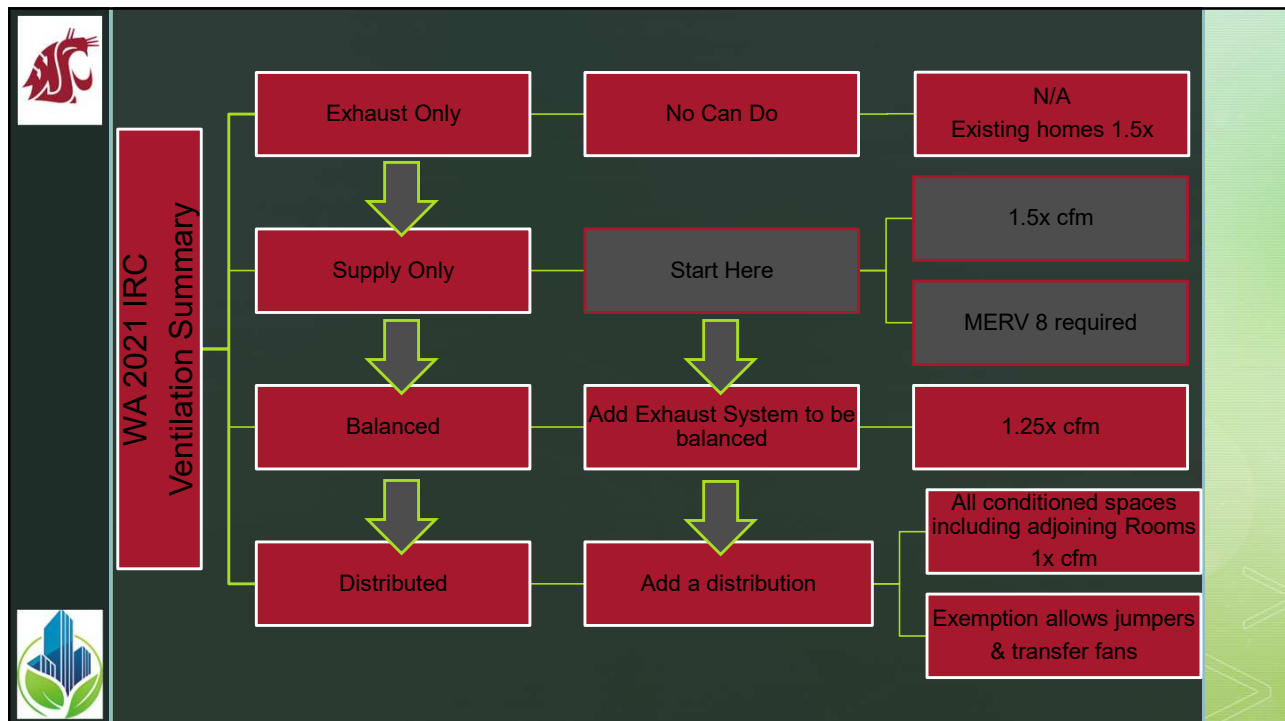
M1505.4.3.2 Intermittent off operation.
 Wholehouse mechanical ventilation systems shall be provided with advanced controls that are configured to operate the system with intermittent off operation shall operate for a least two hours in each 4-hour segment. The whole-house ventilation airflow rate determined in accordance with Section M1505.4.3 as corrected by Section M1505.4.3.1 is multiplied by the factor determined in accordance with Table M1505.4.3.2.

**TABLE M1505.4.3.2
 INTERMITTENT OFF WHOLE-HOUSE MECHANICAL VENTILATION RATE FACTORS^{a, b}**

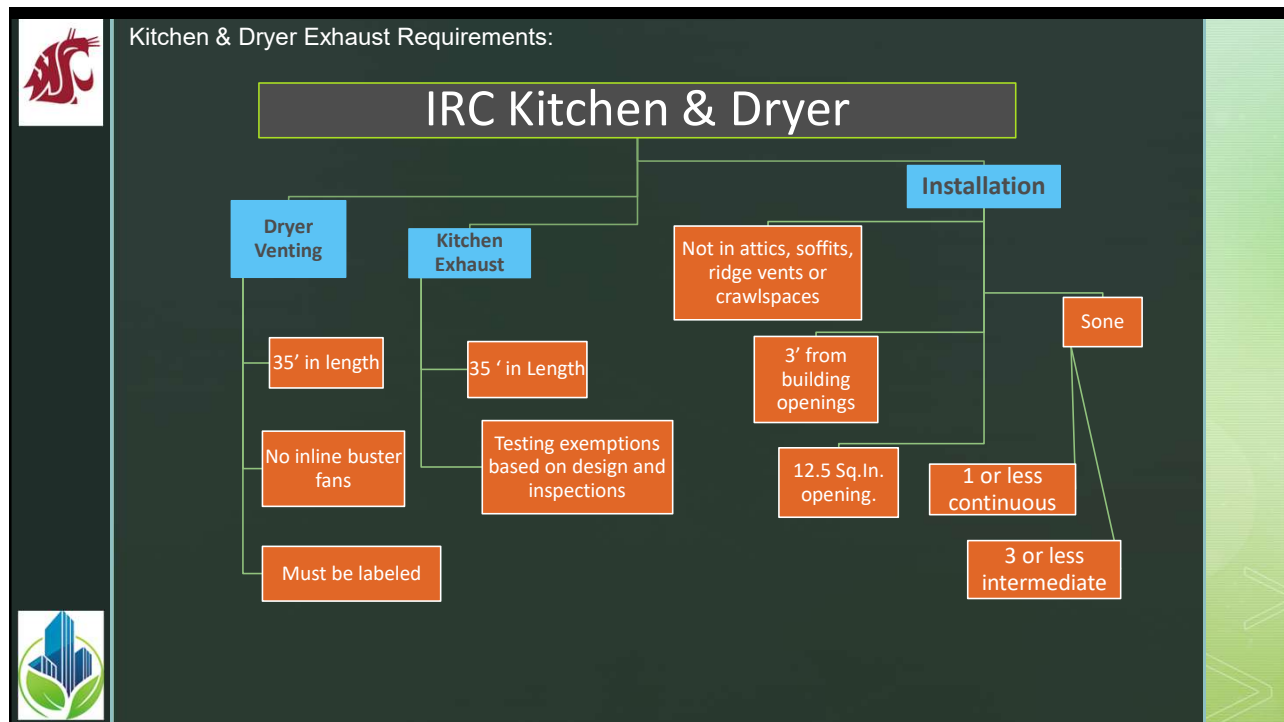
Run-time % in Each 4-hour Segment	50%	66%	75%	100%
Factor ^a	2	1.5	1.3	1.0

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

63



64



65

401.4 Intake opening location.
Air intake openings shall comply with all of the following:



- Intake openings shall be located **not less than 10 feet (3048 mm)** from lot lines or buildings on the same lot. Lot lines shall not be defined as a separation from a street or public way.
- Mechanical and gravity outdoor air intake openings** shall be located not less than **10 feet (3048 mm)** horizontally from any hazardous or noxious contaminant source, such as vents, streets, alleys, parking lots and loading docks, except as specified in Item 3 or **Section 501.3.1**. Outdoor air intake openings shall be permitted to be located less than 10 feet (3048 mm) horizontally from streets, alleys, parking garage entries, parking lots and loading docks provided that the openings are located not less than 25 feet (7620 mm) vertically above such locations. Where openings front on a street or public way, the distance shall be measured from the closest edge of the street or public way.

Exceptions:

- Intake air openings providing less than 500 cfm of outdoor air to Group R occupancies are permitted to be located less than 10 feet (3048 mm) horizontally from parking lots provided that the openings are not less than 15 feet (4572 mm) vertically above the parking lot.
- Intake air openings providing less than 500 cfm of outdoor air to Group R occupancies are permitted to be located less than 10 feet (3048 mm) horizontally from parking lots provided that the openings are not less than 15 feet (4572 mm) vertically above the clear height for vehicles in the parking garage.
- Intake openings shall be **located not less than 3 feet (914 mm)** below contaminant sources where such sources are located within 10 feet (3048 mm) of the opening. Separation is not required between intake air openings, operable openings, and living space *exhaust air* openings of an individual *dwelling unit* or *sleeping unit* where an approved factory-built intake/exhaust combination termination fitting is used to separate the air streams in accordance with the manufacturer's instructions. For these combined terminations, the exhaust air concentration within the intake airflow shall not exceed 10 percent as established by the manufacturer, in accordance with ASHRAE 62.2 Section 6.8, Exception 4. A minimum of 3 feet (914 mm) separation shall be maintained between other environmental air exhaust outlets and other dwelling or sleeping unit factory-built intake/exhaust combination termination fittings.

Exception: Enclosed parking garage and repair garage ventilation air intakes are permitted to be located less than 10 feet (3048 mm) horizontally from or 25 feet (7620 mm) vertically above a street, alley, parking lot and loading dock.

66

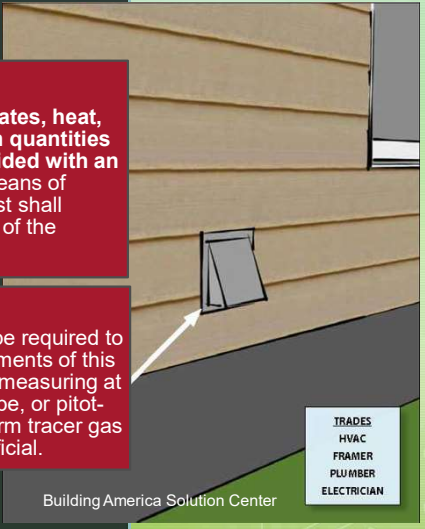



401.6 Contaminant sources.

- Stationary local sources producing airborne particulates, heat, odors, fumes, spray, vapors, smoke or gases in such quantities as to be irritating or injurious to health shall be provided with an exhaust system in accordance with Chapter 5 or a means of collection and removal of the contaminants. Such exhaust shall discharge directly to an *approved* location at the exterior of the building.

401.7 Testing and balancing.



- At the discretion of the building official, flow testing may be required to verify that the mechanical system(s) satisfies the requirements of this chapter. Flow testing may be performed using flow hood measuring at the intake or exhaust points of the system, in-line pitot tube, or pitot-traverse-type measurement systems in the duct, short-term tracer gas measurements, or other means *approved* by the code official.

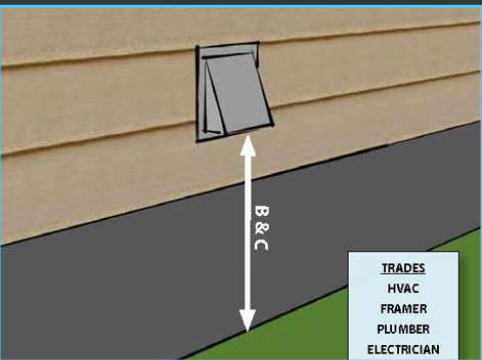


TRADES
HVAC
FRAMER
PLUMBER
ELECTRICIAN

Building America Solution Center

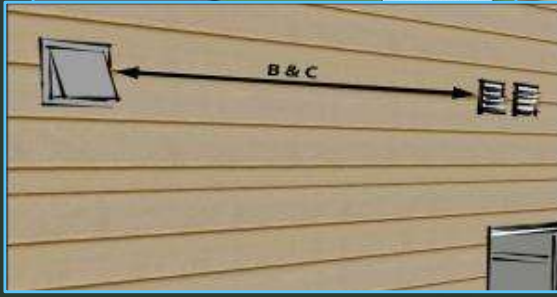
67

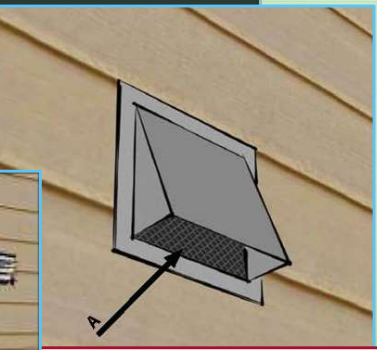





TRADES
HVAC
FRAMER
PLUMBER
ELECTRICIAN

Verify that inlet meets height and clearance requirements






Verify that all inlets are covered by a mesh screen with hole size at most 0.5 inches.

Building America Solution Center

68



403.4 Group R whole house mechanical ventilation system. Each dwelling unit or sleeping unit shall be equipped with a whole house mechanical ventilation system that complies with Sections 403.4.1 through 403.4.6. Each dwelling unit or sleeping unit shall be equipped with local exhaust complying with Section 403.4.7. All occupied spaces, including public corridors, other than the Group R dwelling units and/or sleeping units, that support the Group R occupancy shall meet the natural ventilation of Section 402 or the mechanical ventilation requirements of Sections 403.1 through 403.3.

Exception: Alternate balanced whole house ventilation systems and local exhaust systems subject to the Washington State Energy Code, Residential Provisions serving Group R dwelling units designed and commissioned in accordance with ASHRAE Standard 62.2 are permitted.

403.4.1 System design. The whole house ventilation system shall consist of one or more supply fans, one or more exhaust fans, or an ERV/HRV with integral fans; and the associated ducts and controls. Local exhaust fans shall be permitted to serve as part of the whole house ventilation system when provided with the proper controls in accordance with Section 403.4.5. The systems shall be designed and installed to supply and exhaust the minimum outdoor airflow rates in accordance with Section 403.4.2 as corrected by the balanced and/or distributed whole house ventilation system coefficients in accordance with Section 403.4.3 where applicable.

403.4.2 Whole house mechanical ventilation rates. The sleeping unit whole house mechanical ventilation minimum outdoor airflow rate shall be determined in accordance with the breathing zone ventilation rates minimum outdoor airflow rate shall be determined in accordance with the breathing zone ventilation rates requirements of Section 403.3.1.1.1.2 using Equation 4-2. The dwelling unit whole house mechanical ventilation minimum outdoor airflow rate shall be determined in accordance with Equation 4-10 or Table 403.4.2.

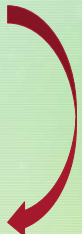
(Equation 4-10)

where:

Q_r = Ventilation airflow rate, cubic feet per minute (cfm) but not less than 30 cfm for each dwelling unit.


A_{floor} = Conditioned floor area, square feet (ft²)

N_{br} = Number of bedrooms, not less than one.



This means balanced

This is calculated ventilation in residential spaces



69




TABLE 403.4.2
WHOLE HOUSE MECHANICAL VENTILATION AIRFLOW RATE
(CONTINUOUSLY OPERATING SYSTEM)

Floor area (ft ²)	Bedrooms ¹				
	1	2	3	4	≥5
<500	30	30	35	45	50
500 – 1000	30	35	40	50	55
1001 – 1500	30	40	45	55	60
1501 – 2000	35	45	50	60	65
2001 – 2500	40	50	55	65	70
2501 – 3000	45	55	60	70	75
3001 – 3500	50	60	65	75	80
3501 – 4000	55	65	70	80	85
4001 – 4500	60	70	75	85	90
4501 – 5000	65	75	80	90	95

1. Minimum airflow (Q_r) is set at not less than 30 cfm for each dwelling unit.


TABLE 403.4.6.5
INTERMITTENT WHOLE HOUSE MECHANICAL VENTILATION RATE FACTORS^{a,b}

Run-time Percentage 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.

Table 403.4.3
SYSTEM COEFFICIENT (C_{system})

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



70






403.4.4.1 Whole house ventilation in Group R-2 occupancies. Residential dwelling and sleeping units in Group R-2 occupancies system shall include supply and exhaust fans and be a balanced whole house ventilation system in accordance with Section 403.4.6.3. The system shall include a heat or energy recovery ventilator with a sensible heat recovery effectiveness as prescribed in Section C403.3.5 or when selected as an option of R406 of the *Washington State Energy Code*. The whole house ventilation system shall operate continuously at the minimum ventilation rate determined in accordance with Section 403.4. The whole house supply fan shall provide ducted outdoor ventilation air to each habitable space within the residential unit.


Exceptions:

1. *Interior adjoining spaces* that are ventilated from another habitable space are not required to have outdoor air ducted directly to the adjoining space. These systems are considered *not distributed whole house ventilation systems* and shall use the "not distributed" quality adjustment system coefficient in accordance with Section 403.4.3.
2. *Interior adjacent rooms* that are ventilated from another habitable space are not required to have outdoor air ducted directly to the *interior adjacent room*. These systems are considered *not distributed whole house ventilation systems* and shall use the "not distributed" quality adjustment system coefficient in accordance with Section 403.4.3. The *interior adjacent room* shall be provided with a transfer fan with a minimum airflow rate of 30 cfm or with relief air inlet with a minimum airflow of 20 cfm that is connected to the exhaust/relief air inlet of an ERV/HRV whole house ventilation system. Transfer fans that ventilate *interior adjacent rooms* shall meet the same rating in Section 403.4.6 and shall have whole house ventilation controls in accordance with Section 403.4.5.

403.4.4.2 Whole house ventilation for other than Group R-2 occupancies. Residential dwelling and sleeping units in other than Group R-2 occupancies, including I-1 condition 2 occupancies, shall have a whole house mechanical ventilation system with supply and exhaust fans in accordance with Section 403.4.6.1, 403.4.6.2, 403.4.6.3, or 403.4.6.4. The whole house ventilation system shall operate continuously at the minimum ventilation rate determined in accordance with Section 403.4.2 unless configured with intermittent off controls in accordance with Section 403.4.6.5. The whole house supply fan shall provide ducted outdoor ventilation air to each habitable space within the residential unit.






71

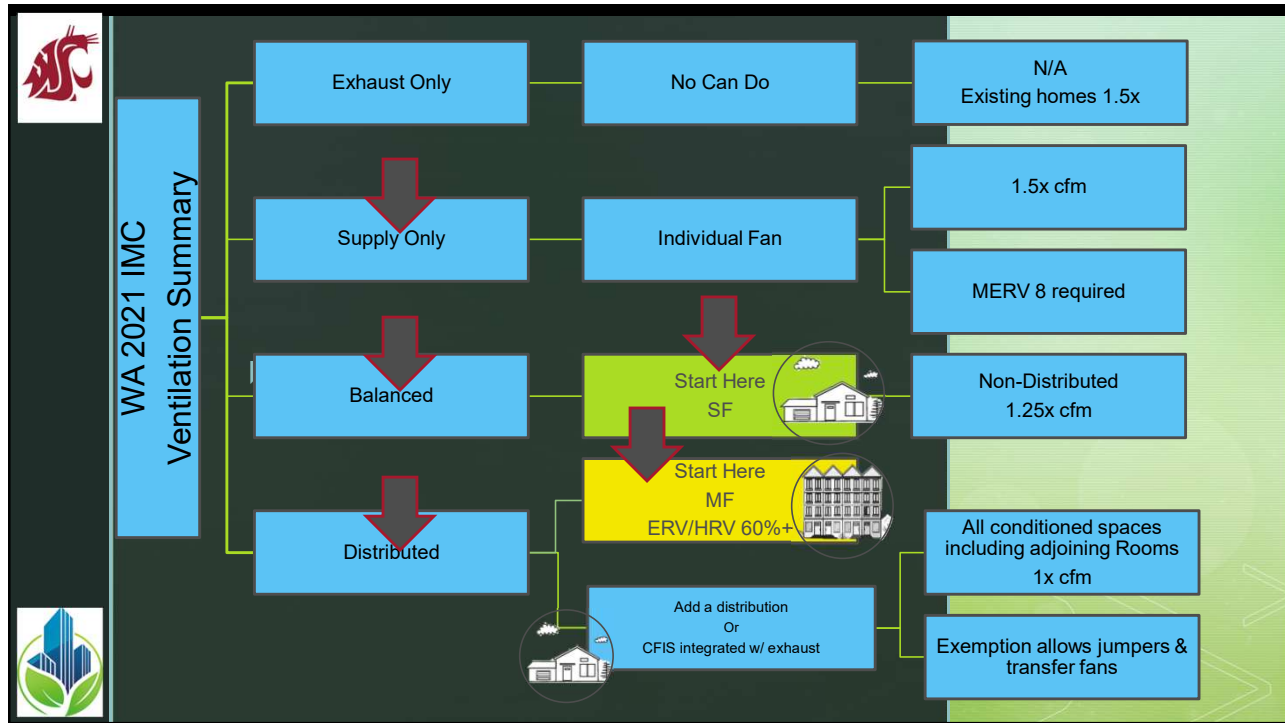


403.4.6.6 Testing. Whole house mechanical ventilation systems shall be tested, balanced and verified to provide a flow rate not less than the minimum required by Sections 403.4.2 and 403.4.3. Testing shall be performed according to the ventilation equipment manufacturer's instructions, or by using a flow hood, flow grid, or other airflow measuring device at the mechanical ventilation fan's inlet terminals, outlet terminals or grilles or in the connected ventilation ducts. Where required by the building official, testing shall be conducted by an approved third party. A written report of the results of the test shall be signed by the party conducting the test and provided to the building official and shall be posted in the residential unit in accordance with Section 403.4.6.7.

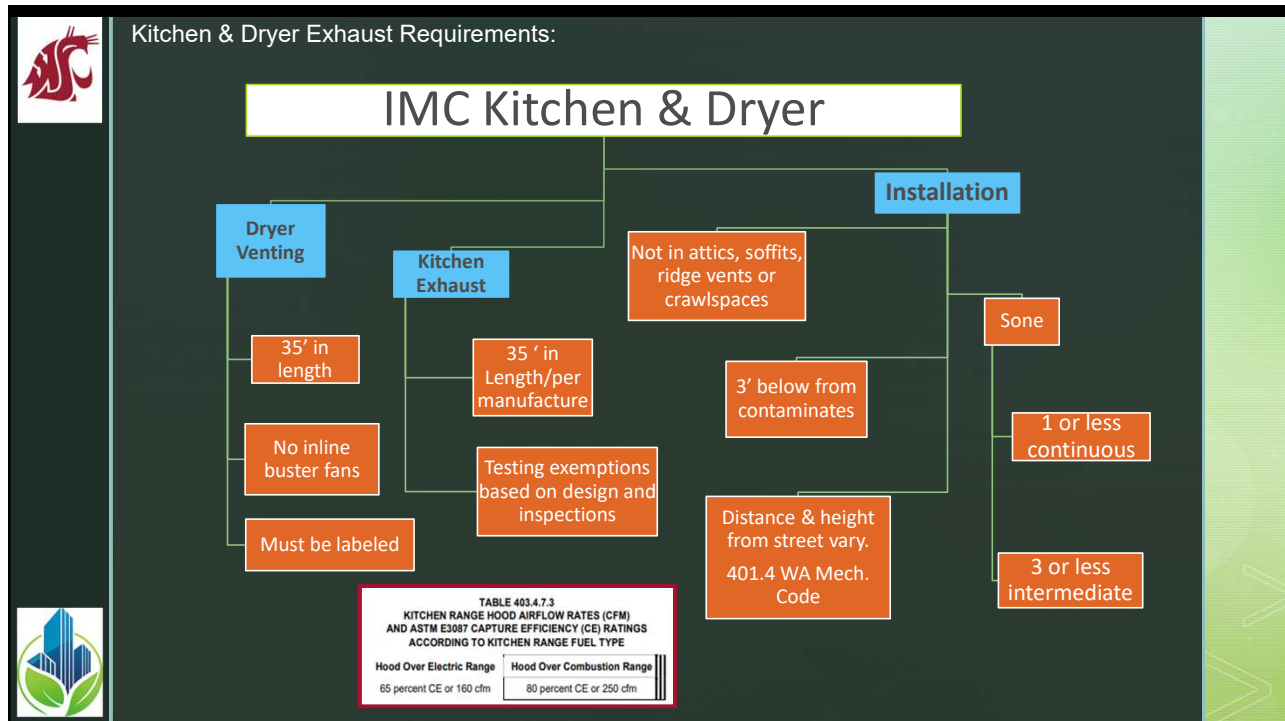
403.4.6.7 Certificate. A permanent certificate shall be completed by the mechanical contractor, test and balance contractor or other approved party and posted on a wall in the space where the furnace is located, a utility room, or an approved location inside the building. When located on an electrical panel, the certificate shall not cover or obstruct the visibility of the circuit directory label, service disconnect label, or other required labels. The certificate shall list the flow rate determined from the delivered airflow of the whole house mechanical ventilation system as installed and the type of mechanical whole house ventilation system used to comply with Section 403.4.3.



72



73



74



Thank you to our sponsor




About NEEA
Our Purpose - *The Northwest Energy Efficiency Alliance (NEEA) is an alliance of utilities and energy efficiency organizations that pools resources and shares risks to transform the market for energy efficiency to the benefit of consumers in the Northwest.*

(<https://neea.org/about-neea>)




75



Any mention of trade names, commercial products and organizations in this document does not imply endorsement by Washington State University's Energy Program (WSUEP). The WSUEP and its collaborators make no warranties, whether expressed or implied, nor assume any legal liability or responsibility for the accuracy, completeness or usefulness of the contents of this publication, or any portion thereof, nor represent that its use would not infringe privately owned rights. Further, the WSUEP cannot be held liable for construction defects or deficiencies resulting from the proper or improper application of the content of this education.

Our WSEC-Residential technical support team is not an affiliate of, nor do we speak for, the Washington State Building Code Council (SBCC). Official opinions of WSEC intent are made only by the SBCC in response to official inquiries submitted to the SBCC by authorities having jurisdiction. While we try to stay aligned with the SBCC, the technical support we provide is advisory only and non-binding on authorities having jurisdiction, builders, designers, and the building trades personnel involved with construction and remodeling of residential structures.



76

Acknowledgments & Additional Credits

First we must give credit to ICC, whom many slides were gleaned from or copied as there are embodied code text language. We are not able to change the wording as that may have an effect on the our come of the intent of the original language.

It was gleaned for educational purposes only and copies of the full bodied text books from ICC will be necessary to follow along with the classes.

<https://codes.iccsafe.org/>



[Link to Phone \(android\):](#)