Washington State Energy Code
2018 Residential

Effective February 1, 2021
(original effective date was July 1, 2020)

Mike Lubliner, Building Science Specialist

WASHINGTON STATE UNIVERSITY
ENERGY PROGRAM
www.energy.wsu.edu

WSU Code Support Services

Technical support provided in Washington:

- Training (in person, webinars, video)
- Phone and email inquiry hotline support
- Energy code compliance tools
- Website with educational resources:

  WSU Energy Code website

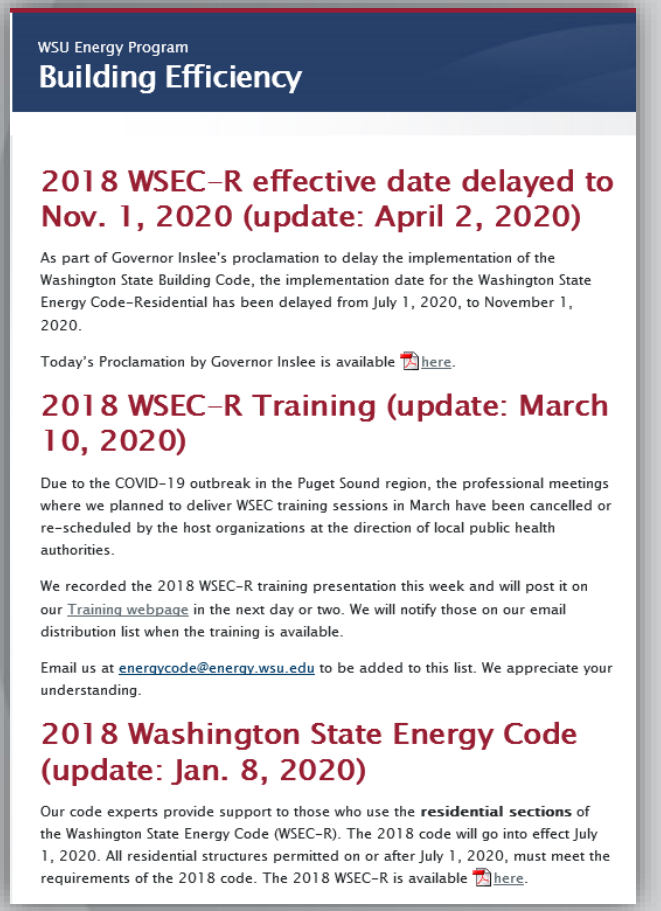
WSU Technical Assistance Services

- Delivered 80 WSEC-R 2015 trainings to 2,100 attendees
- Reply to over 2,000 hotline calls and emails annually
- Participate in SBCC Energy & Mechanical TAGs

Energy Code Support in WA State

Residential - Spend an hour on our web page!

- WSU Energy Program
- 360-956-2042
- energycode@energy.wsu.edu
- www.energy.wsu.edu/code
- *Mike Lubliner, Melinda Spencer, Carolyn Roos*



WSU Energy Program

Building Efficiency

2018 WSEC–R effective date delayed to Nov. 1, 2020 (update: April 2, 2020)

As part of Governor Inslee's proclamation to delay the implementation of the Washington State Building Code, the implementation date for the Washington State Energy Code–Residential has been delayed from July 1, 2020, to November 1, 2020.

Today's Proclamation by Governor Inslee is available here.

2018 WSEC–R Training (update: March 10, 2020)

Due to the COVID–19 outbreak in the Puget Sound region, the professional meetings where we planned to deliver WSEC training sessions in March have been cancelled or re–scheduled by the host organizations at the direction of local public health authorities.

We recorded the 2018 WSEC–R training presentation this week and will post it on our Training webpage in the next day or two. We will notify those on our email distribution list when the training is available.

Email us at energycode@energy.wsu.edu to be added to this list. We appreciate your understanding.

2018 Washington State Energy Code (update: Jan. 8, 2020)

Our code experts provide support to those who use the **residential sections** of the Washington State Energy Code (WSEC–R). The 2018 code will go into effect July 1, 2020. All residential structures permitted on or after July 1, 2020, must meet the requirements of the 2018 code. The 2018 WSEC–R is available here.

Non-residential

- Evergreen Technology Consulting
- 360-539-5300
- com.techsupport@waenergycodes.com
- http://waenergycodes.com
- *Lisa Rosenow*

2018 WSEC-R: Past, Current and Future

45% energy savings

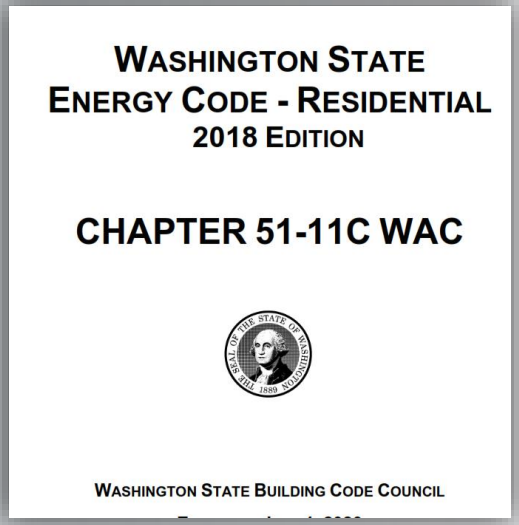
(or 55% of the energy consumption in 2006)

	2006	2009	2012	2015	2018	2021	2024	2027	2030
WA Target: 8.75% Savings/cycle over 2006	100%	91%	83%	74%	65%	56%	48%	39%	30%
WA Target: 14% Savings over Previous Cycle	100%	86%	74%	64%	55%	47%	41%	35%	30%
Modeled Energy Use (Compared to 2006)	**100%**	**83%***	**76%***	**68%**	**55%**				

*Values sourced from the *2012 Washington State Energy Code Legislative Report*

Code Chapters

- Chapter 1 - Scope and Administration
- Chapter 2 - Definitions
- Chapter 3 - General Requirements
- **Chapter 4 - Residential Energy Efficiency**
- Chapter 5 - Existing Buildings
- Chapter 6 - Reference Standards
- Appendix A - Default Heat Loss U-Factors
- Appendix RA/RB - R405 Optional Energy Measures
- Appendix C - Exterior Design Conditions



Chapter 4
Residential Energy Efficiency

- R401 - General
- R402 - Building Envelope
- R403 - Mechanical Systems
- R404 - Electrical Power & Lighting
- R405 - Simulated Performance Alternative
- R406 - Additional Energy Efficiency Credits
- R407 - Certified Passive House

R401- General

401.2 - Compliance Paths

- R402.1 - Prescriptive & R406
- R402.1.4 - UA Alternative & R406
- R405 - Simulated Performance Alternative & R406
- R406 - Energy Credits for SF and low-rise MF (raised #)
- R407 - Certified Passive House (new)

Note: Energy Rating Index (ERI/HERS Index) is **not** an approved compliance path in Washington. However, ERI may be used by energy raters for IRS $2,000/home builder tax credits.

Prescriptive R-Value

TABLE R402.1.1
INSULATION AND FENESTRATION REQUIREMENTS BY COMPONENT[a]

CLIMATE ZONE 5 AND MARINE 4	
Fenestration U-Factor[b]	0.30
Skylight[b] U-Factor	0.50
Ceiling R-Value[e]	49
Wood Frame Wall[g,h] R-Value	21 int
Floor R-Value	30
Below-Grade[c,h] Wall R-value	10/15/21 int + 5TB
Slab[d,f] R-Value & Depth	10, 2 ft

Additional Energy Credits - Yikes

R406.1 Scope. This section establishes additional energy efficiency requirements for all new construction covered by this code, including additions subject to Section R502 and change of occupancy or use subject to Section R505 unless specifically exempted in Section R406. Credit from both Sections R406.2 and R406.3 are required.

Additional Energy Credits (cont.)

R406.3 Additional energy efficiency requirements. Each dwelling unit in a residential building shall comply with sufficient options from Table R406.2 so as to achieve the following minimum number of credits:

1. Small Dwelling Unit: ..... 3.0 credits
   Dwelling units less than 1500 square feet in conditioned floor area with less than 300 square feet fenestration area. Additions to existing building greater than 500 square feet of heated floor area b less than 1500 square feet.
2. Medium Dwelling Unit: ..... 6.0 credits
   All dwelling units that are not included in #1, #3 or #4.
3. Large Dwelling Unit: ..... 7.0 credits
   Dwelling units exceeding 5000 square feet of conditioned floor area.
4. Dwelling units serving R-2 occupancies: ..... 4.5 credits
5. Additions less than or equal to 500 square feet: ..... 1.5 credits

The drawings included with the building permit application shall identify which options have been selected and the point value of each option, regardless of whether separate mechanical, plumbing, electrical, or other permits are utilized for the project.

Dwelling or Sleeping Unit Energy Credits

- Small *(<1,500 sf)*
  - 1.5 credits in 2015 **(3.0 starting Feb. 1, 2021)**
- Medium *(1,500 – 5,000 sf)*
  - 3.5 credits in 2015 **(6.0 starting Feb. 1, 2021)**
- Large *(>5,000 sf)*
  - 4.5 credits in 2015 **(7.0 starting Feb. 1, 2021)**

Dwelling or Sleeping Unit Energy Credits (cont.)

- Low-rise multifamily (all sizes)
  - 1.5 credits in 2015 **(4.5 starting Feb. 1, 2021)**
- Additions less than 500 sf
  - 0.5 credit in 2015 **(1.5 starting Feb. 1, 2021)**

R406.2 – Fuel Normalization - Yikes

R406.2 Carbon emission equalization. This section establishes a base equalization between fuels used to define the equivalent carbon emissions of the options specified. The permit shall define the base fuel selection to be used and the points specified in Table R406.2 shall be used to modify the requirements in Section R406.3. The sum of credits from Tables R406.2 and R406.3 shall meet the requirements of Section R406.3.

R406.2 - Fuel Normalization

TABLE R406.2
FUEL NORMALIZATION CREDITS

System Type	Description of Primary Heating Source	Credits	
		All Other	Group R-2
1	Combustion heating equipment meeting minimum federal efficiency standards for the equipment listed in Table C403.3.2(4) or C403.3.2(5)	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(1)C or C403.3.2(2) **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	1.0	1.0
3	For heating system based on electric resistance only (either forced air or Zonal)	-1.0	-1.0
4	For heating system based on electric resistance with a ductless mini-split heat pump system in accordance with Section R403.7.1 including the exception	0.5	N/A
5	All other heating systems	-1	-0.5

(1) Envelope Credits

OPTION	DESCRIPTION	CREDIT(S)	
		All Other	Group R-2
1. EFFICIENT BUILDING ENVELOPE OPTIONS **Only one option from Items 1.1 through 1.7 may be selected in this category.** Compliance with the conductive UA targets is demonstrated using Section R402.1.4, Total UA alternative, where [1-(Proposed UA/Target UA)] > the required %UA reduction			
1.1	Prescriptive compliance is based on Table R402.1.1 with the following modifications: Vertical fenestration **U = 0.24**	0.5	0.5
1.2	Prescriptive compliance is based on Table R402.1.1 with the following modifications: Vertical fenestration **U = 0.20**	1.0	1.0
1.3	Prescriptive compliance is based on Table R402.1.1 with the following modifications: Vertical fenestration **U = 0.28** **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 R402.1.4: Reduce the Total conductive UA by **5%**	0.5	N/A
1.4	Prescriptive compliance is based on Table R402.1.1 with the following modifications: **Vertical fenestration U = 0.25** **Wall R-21 plus R-4 ci** **Floor R-38** Basement wall **R-21** int plus **R-5** 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 R402.1.4: Reduce the Total conductive UA by **15%**	1.0	1.0
1.5	Prescriptive compliance is based on Table R402.1.1 with the following modifications: **Vertical fenestration U = 0.22** Ceiling and single-rafter or joist-vaulted **R-49** 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 R402.1.4: Reduce the Total conductive UA by **30%**	2.0	1.5

(1) Envelope Credits (cont.)

OPTION	DESCRIPTION	CREDIT(S)	
		All Other	Group R-2
1.6	Prescriptive compliance is based on Table R402.1.1 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 R402.1.4: Reduce the Total conductive UA by 40%.	3.0	2.0
1.7	Advanced framing and raised heel trusses or rafters Vertical Glazing U-0.28 R-49 Advanced (U-0.020) as listed in Section A102.2.1, *Ceilings below a vented attic* **and** R-49 vaulted ceilings with full height of uncompressed insulation extending over the wall top plate at the eaves.	0.5	0.5

(2) Air Leakage Control & Ventilation System Effectiveness Credits

2. AIR LEAKAGE CONTROL AND EFFICIENT VENTILATION OPTIONS Only one option from Items 2.1 through 2.4 may be selected in this category.			
2.1	Compliance based on R402.4.1.2: Reduce the tested air leakage to 3.0 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 0.3 cfm/ft^2 maximum at 50 Pascals **and** All whole house ventilation requirements as determined by Section M1507.3 of the *International Residential Code* or Section 403.8 of the *International Mechanical Code* shall be met with a high efficiency fan(s) (maximum 0.35 watts/cfm), not interlocked with the furnace fan (if present). Ventilation systems using a furnace including an ECM motor are allowed, provided that they are controlled to operate at low speed in ventilation only mode. 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.	0.5	1.0
2.2	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 M1507.3 of the *International Residential Code* or Section 403.8 of the *International Mechanical Code* 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	1.5

(2) Air Leakage Control & Ventilation Credits (cont.)

2.3	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 0.25 cfm/ft^2 maximum at 50 Pascals **and** All whole house ventilation requirements as determined by Section M1507.3 of the *International Residential Code* or Section 403.8 of the *International Mechanical Code* 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	2.0
2.4	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 M1507.3 of the *International Residential Code* or Section 403.8 of the *International Mechanical Code* shall be met with a heat recovery ventilation system with minimum sensible heat recovery efficiency of 0.80. Duct installation shall comply with Section R403.3.7 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	2.5

(3) HVAC Credits

3. HIGH EFFICIENCY HVAC EQUIPMENT OPTIONS Only one option from Items 3.1 through 3.6 may be selected in this category.			
3.1[a]	Energy Star rated (U.S. North) Gas or propane furnace with minimum AFUE of 95% **or** Energy Star rated (U.S. North) Gas or propane boiler with minimum AFUE of 90%. 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.	1.0	1.0
3.2[a]	Air-source centrally ducted heat pump with minimum HSPF of 9.5. 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.	1.0	N/A
3.3[a]	Closed-loop ground source heat pump; with a minimum COP of 3.3 **or** Open loop water source heat pump with a maximum pumping hydraulic head of 150 feet and minimum COP of 3.6. 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.	1.5	1.0
3.4	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 of 10.0 shall be installed and provide heating to the largest zone of the housing unit. 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.	1.5	2.0

(3) HVAC Credits (cont.)

3.5[a]	Air-source, centrally ducted heat pump with minimum HSPF of 11.0. 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.	1.5	N/A
3.6[a]	Ductless split system heat pumps with no electric resistance heating in the primary living areas. A ductless heat pump system with a minimum HSPF of 10 shall be sized and installed to provide heat to entire dwelling unit at the design outdoor air temperature. 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).	2.0	3.0

a. An alternative heating source sized at a maximum of 0.5 Watts/ft^2 (equivalent) of heated floor area or 500 Watts, whichever is bigger, may be installed in the dwelling unit.

(4) HVAC Distribution Credits

4. HIGH EFFICIENCY HVAC DISTRIBUTION SYSTEM OPTIONS			
4.1	All supply and return ducts located in an unconditioned attic shall be deeply buried in ceiling insulation in accordance with Section R403.3.7. For mechanical equipment located outside the conditioned space, a maximum of 10 linear feet of return duct and 5 linear feet of supply duct connections to the equipment may be outside the deeply buried insulation. 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. Duct leakage shall be limited to 3 cfm per 100 square feet of conditioned floor area. Air handler(s) shall be located within the conditioned space.	0.5	0.5
4.2	HVAC equipment and associated duct system(s) installation shall comply with the requirements of Section R403.3.7. Locating system components in conditioned crawl spaces is not permitted under this option. Electric resistance heat and ductless heat pumps are not permitted under this option. Direct combustion heating equipment with AFUE less than 80% is not permitted under this option. To qualify to claim this credit, the building permit drawings shall specify the option being selected and shall specify the heating equipment type and shall show the location of the heating and cooling equipment and all the ductwork.	1.0	N/A

(5) DHW Credits

5. EFFICIENT WATER HEATING OPTIONS Only one option from Items 5.2 through 5.6 may be selected in this category. Item 5.1 may be combined with any option.			
5.1	A drain water heat recovery unit(s) shall be installed, which captures waste water heat from all and only the showers, and has 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. 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.	0.5	0.5
5.2	Water heating system shall include one of the following: Energy Star rated gas or propane water heater with a minimum UEF of 0.80. 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.	0.5	0.5

DHW Credits (cont.)

OPTION	DESCRIPTION	All Other	Group R-2
5.3	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 Systems or Water heater heated by ground source heat pump meeting the requirements of Option 3.3. 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.	1.0	1.0
5.4	Water heating system shall include one of the following: Electric heat pump water heater meeting the standards for Tier I of NEEA's advanced water heating specification or For R-2 Occupancy, electric heat pump water heater(s), meeting the standards for Tier I 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.	1.5	2.0
5.5	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.	2.0	2.5

DHW Credits (cont.)

OPTION	DESCRIPTION	CREDIT(S)	
		All Other	Group R-2
5.6	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 *Advanced Water Heating Specification* 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.	2.5	3.0

(6) Renewable Electric Energy Credits

6. RENEWABLE ELECTRIC ENERGY OPTION			
6.1	For each 1200 kWh of electrical generation per housing unit provided annually by on-site wind or solar equipment a 1.0 credit shall be allowed, up to 3 credits. Generation shall be calculated as follows: For solar electric systems, the design shall be demonstrated to meet this requirement using the National Renewable Energy Laboratory calculator PVWATTs or approved alternate by the code official. Documentation noting solar access shall be included on the plans. For wind generation projects designs shall document annual power generation based on the following factors: 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. 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.	1.0	1.0

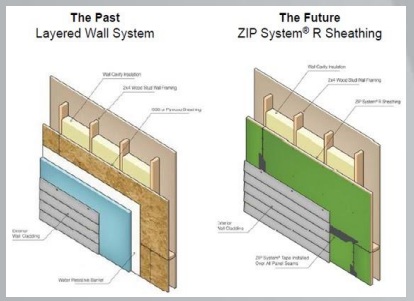
(7) Appliance Credits

7. APPLIANCE PACKAGE OPTION			
7.1	All of the following appliances shall be new and installed in the dwelling unit and shall meet the following standards: Dishwasher – Energy Star rated Refrigerator (if provided) – Energy Star rated Washing machine – Energy Star rated Dryer – Energy Star rated, ventless dryer with a minimum CEF rating of 5.2. 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 dwelling unit.	0.5	1.5

All Electric Heat Pump
1,500 to 5,000 sf homes (6.0 credits)

Opt	Description – Nov. 1, 2020	Pts
3.2 (a)	HSPF 9.5 centrally ducted heat pump	1.0
4.2	All ducts and furnace inside the conditioned space	1.0
2.1	3 ACH_{50}, Energy Star 0.3 cfm/sf	0.5
1.3	R-38 floors (R10 under slab) and U-0.28 windows and door average	0.5
5.5	Heat pump water heater NEEA Tier III	2.0
Heat HP	Fuel equalization heat pump credit	1.0
	Total	**6.0**

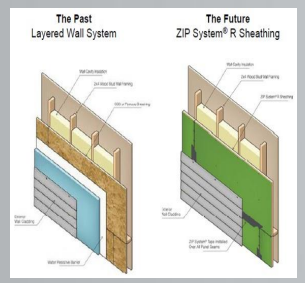
Heat Pump & Gas DHW
1,500 to 5,000 sf homes (6.0 credits)



Opt	Description – Nov. 1, 2020	Pts
3.5a	11.0 HSPF centrally ducted heat pump	1.5
4.2	All ducts and furnace inside conditioned space	1.0
2.1	3 ACH_{50}, Energy Star 0.3 cfm/sf	0.5
1.4	U-0.25 windows, R38 crawl/R10 under slab, R21 with R4 CI on exterior walls	1.0
5b	Gas water heater ≥ 0.91 UEF	1.0
Heat HP	Fuel equalization heat pump credit	1.0
	Total	**6.0**

Gas Heat + HPWH

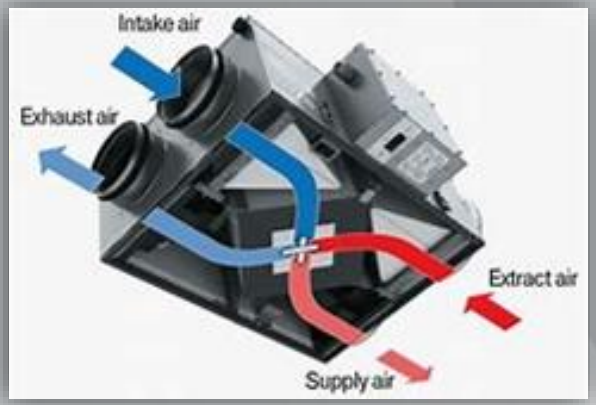
1,500 to 5,000 sf homes (6.0 credits)



Opt	Description – Nov. 1, 2020	Pts
3.1a	95% AFUE gas furnace	1.0
4.2	All ducts and furnace inside conditioned space	1.0
2.1	3 ACH_{50}, Energy Star 0.3 cfm/sf	0.5
1.4	U-0.25 windows, R38 crawl/R10 under slab, R21 with R4 CI exterior walls	1.0
7.1	Appliance Credit: Energy Star dishwasher, washer, refrigerator (if provided) and vent-less dryer (CEF 5.2)	0.5
5b	Heat pump water heater NEEA Tier III	2.0
	Total	**6.0**

DHP + Electric Heat
Multifamily - Low-rise R2

Opt	Description – Nov. 1, 2020	Pts
3.4	DHP with electric resistance	2.0
1.2	Triple pane window U=0.22	1.0
2.1	0.25 cfm50/sf unit sf (or 2 ACH_{50}) + 65% HRV/ERV – tested!!!	1.5
	Total	**4.5**



HSPF 10 VRF-HP
Multifamily - low-rise R2

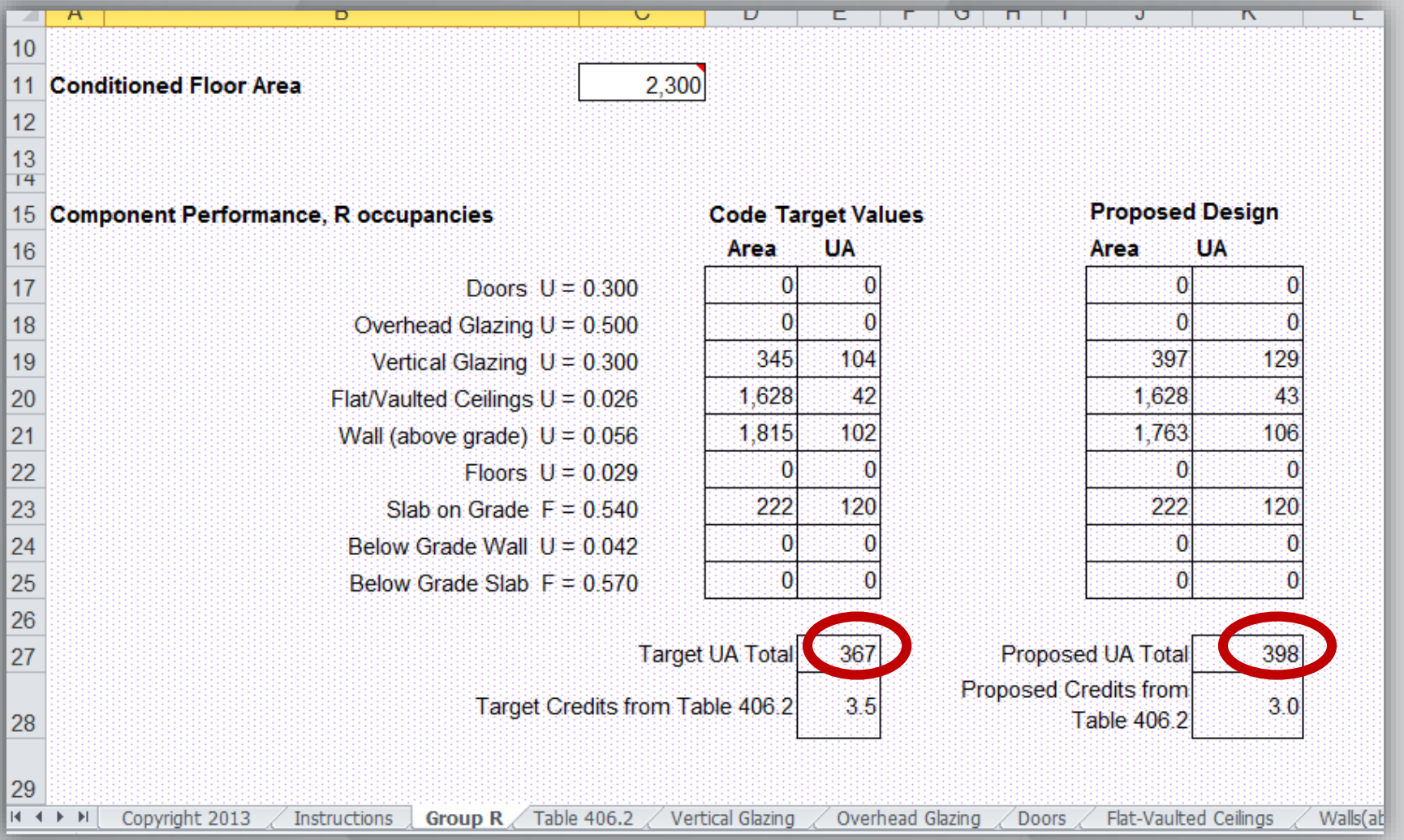
Opt	Description – Nov. 1, 2020	Pts
2	Fuel equalization – HP	1.0
3.6	All HSPF 10 (ducted cassette)	3.0
2.2	0.25 cfm 50/sf unit sf (or 2 ACH_{50}) + 65% HRV/ERV – tested!!!	1.5
	Total	**5.5**

R402.1.4 Total UA Alternative

- Total UA Alternative is typically used when prescriptive path assembly is not a viable option.
- Default U-factors - typical assemblies are in Appendix A.
- Unlike the prescriptive path, which allows unlimited fenestration (e.g., windows), the UA Alternative and the simulated performance path use 15% in the target home.

UA Alternative Example

Building Envelope Trade-Off



Conditioned Floor Area	2,300	

Component Performance, R occupancies	**Code Target Values**		**Proposed Design**	
	Area	**UA**	**Area**	**UA**
Doors U = 0.300	0	0	0	0
Overhead Glazing U = 0.500	0	0	0	0
Vertical Glazing U = 0.300	345	104	397	129
Flat/Vaulted Ceilings U = 0.026	1,628	42	1,628	43
Wall (above grade) U = 0.056	1,815	102	1,763	106
Floors U = 0.029	0	0	0	0
Slab on Grade F = 0.540	222	120	222	120
Below Grade Wall U = 0.042	0	0	0	0
Below Grade Slab F = 0.570	0	0	0	0
Target UA Total		367	Proposed UA Total	398
Target Credits from Table 406.2		3.5	Proposed Credits from Table 406.2	3.0

Copyright 2013 | Instructions | **Group R** | Table 406.2 | Vertical Glazing | Overhead Glazing | Doors | Flat-Vaulted Ceilings | Walls(ab

R405 – Simulated Performance Alternative

R405.1 Scope. This section establishes criteria for compliance using simulated energy performance analysis. Such analysis shall include heating, cooling, mechanical ventilation and service water heating energy only.

- 15% target home also used for standard reference home, just like UA tradeoff compliance. This makes it harder to comply when building over 15%.
- WSU is not aware of software that currently meets the requirements of Table 405.5.2(1).
- We may see this for Energy Raters working with builders who desire IRS tax credits in 2020.

R401.3 Certificate

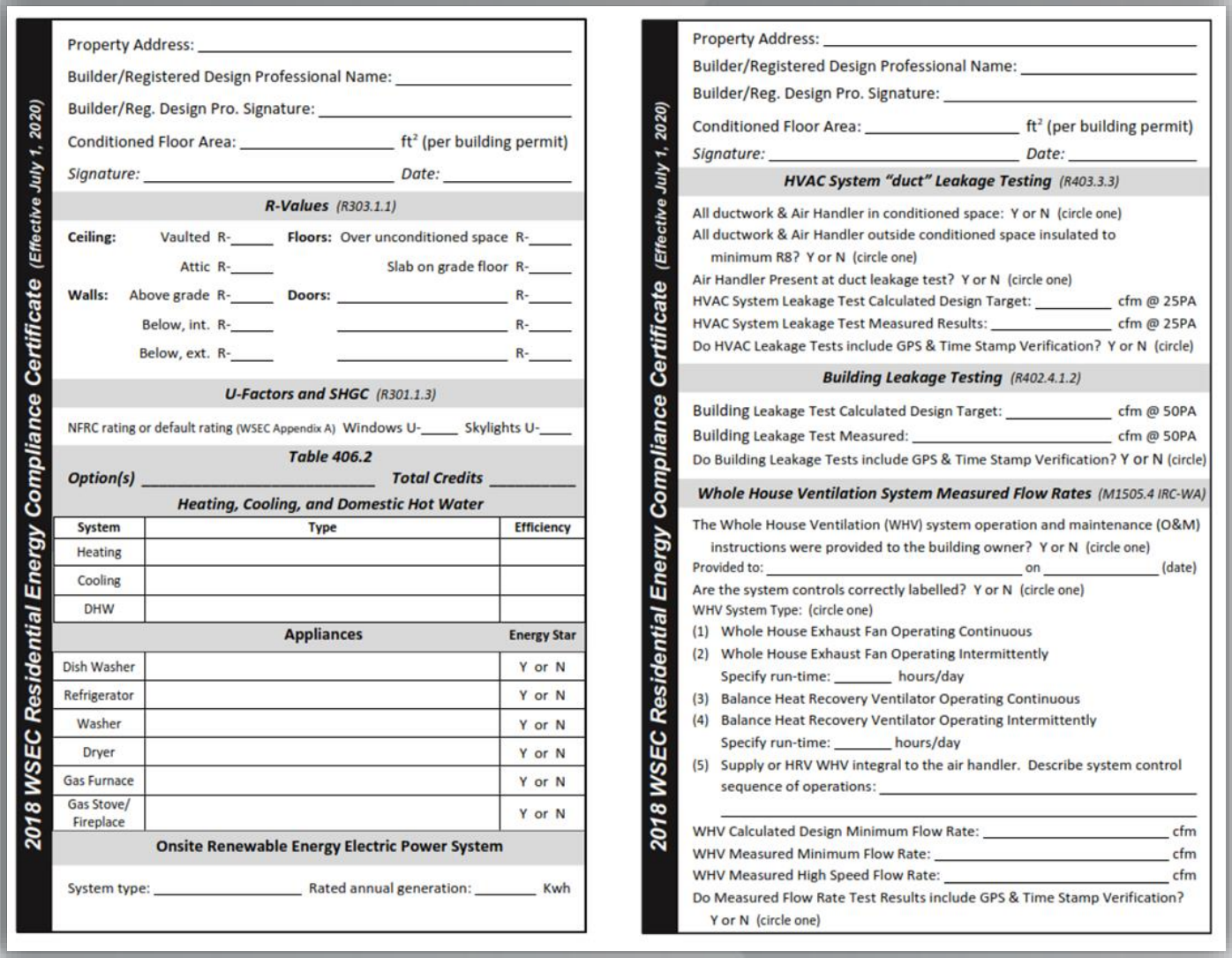
- A permanent certificate shall be completed by the builder or other approved party
- Post on a wall in the space where the furnace is located, utility room or an approved location inside
- The certificate shall list the R-values of insulation: ceiling/roof, walls, foundation (slab, below-grade wall, and/or floor), and ducts outside conditioned spaces
- U-factors for fenestration (see glazing worksheet)

R401.3 Certificate (cont.)

- Types and efficiencies:
  - HVAC
  - DHW service water heating
  - Appliances
  - Renewables
- Test results & documentation:
  - Ductwork air leakage by certified tester (per RS-33)
  - Envelope air leakage
  - Ventilation flow rate testing & commissioning

R401.3 Certificate - New (cont.)

Code official **may** require that test documentation include an electronic record of the time, date and location of the test, using a date-stamped smart phone photo or air leakage testing software.



2018 WSEC Residential Energy Compliance Certificate (Effective July 1, 2020)

Property Address: _____

Builder/Registered Design Professional Name: _____

Builder/Reg. Design Pro. Signature: _____

Conditioned Floor Area: _____ ft² (per building permit)

Signature: _____ *Date:* _____

R-Values *(R303.1.1)*

Ceiling:	Vaulted R-____	**Floors:**	Over unconditioned space	R-____
	Attic R-____		Slab on grade floor	R-____
Walls:	Above grade R-____	**Doors:**	_____	R-____
	Below, int. R-____		_____	R-____
	Below, ext. R-____		_____	R-____

U-Factors and SHGC *(R301.1.3)*

NFRC rating or default rating (WSEC Appendix A) Windows U-____ Skylights U-____

Table 406.2

Option(s) _____ ***Total Credits*** _____

Heating, Cooling, and Domestic Hot Water

System	Type	Efficiency
Heating		
Cooling		
DHW		

Appliances		Energy Star
Dish Washer		Y or N
Refrigerator		Y or N
Washer		Y or N
Dryer		Y or N
Gas Furnace		Y or N
Gas Stove/ Fireplace		Y or N

Onsite Renewable Energy Electric Power System

System type: _____ Rated annual generation: _____ Kwh

2018 WSEC Residential Energy Compliance Certificate (Effective July 1, 2020)

Property Address: _____

Builder/Registered Design Professional Name: _____

Builder/Reg. Design Pro. Signature: _____

Conditioned Floor Area: _____ ft² (per building permit)

Signature: _____ *Date:* _____

HVAC System "duct" Leakage Testing *(R403.3.3)*

All ductwork & Air Handler in conditioned space: Y or N (circle one)
All ductwork & Air Handler outside conditioned space insulated to minimum R8? Y or N (circle one)
Air Handler Present at duct leakage test? Y or N (circle one)
HVAC System Leakage Test Calculated Design Target: _____ cfm @ 25PA
HVAC System Leakage Test Measured Results: _____ cfm @ 25PA
Do HVAC Leakage Tests include GPS & Time Stamp Verification? Y or N (circle)

Building Leakage Testing *(R402.4.1.2)*

Building Leakage Test Calculated Design Target: _____ cfm @ 50PA
Building Leakage Test Measured: _____ cfm @ 50PA
Do Building Leakage Tests include GPS & Time Stamp Verification? Y or N (circle)

Whole House Ventilation System Measured Flow Rates *(M1505.4 IRC-WA)*

The Whole House Ventilation (WHV) system operation and maintenance (O&M) instructions were provided to the building owner? Y or N (circle one)
Provided to: _____ on _____ (date)
Are the system controls correctly labelled? Y or N (circle one)
WHV System Type: (circle one)
(1) Whole House Exhaust Fan Operating Continuous
(2) Whole House Exhaust Fan Operating Intermittently
Specify run-time: _____ hours/day
(3) Balance Heat Recovery Ventilator Operating Continuous
(4) Balance Heat Recovery Ventilator Operating Intermittently
Specify run-time: _____ hours/day
(5) Supply or HRV WHV integral to the air handler. Describe system control sequence of operations: _____

WHV Calculated Design Minimum Flow Rate: _____ cfm
WHV Measured Minimum Flow Rate: _____ cfm
WHV Measured High Speed Flow Rate: _____ cfm
Do Measured Flow Rate Test Results include GPS & Time Stamp Verification? Y or N (circle one)

R401.3 Certificate (new HVAC tests)

HVAC System "duct" Leakage Testing *(R403.3.3)*

All ductwork & Air Handler in conditioned space: Y or N (circle one)

All ductwork & Air Handler outside conditioned space insulated to minimum R8? Y or N (circle one)

Air Handler Present at duct leakage test? Y or N (circle one)

HVAC System Leakage Test Calculated Design Target: _____ cfm @ 25PA

HVAC System Leakage Test Measured Results: _____ cfm @ 25PA

Do HVAC Leakage Tests include GPS & Time Stamp Verification? Y or N (circle)

Building Leakage Testing *(R402.4.1.2)*

Building Leakage Test Calculated Design Target: _____ cfm @ 50PA

Building Leakage Test Measured: _____ cfm @ 50PA

Do Building Leakage Tests include GPS & Time Stamp Verification? Y or N (circle)

Whole House Ventilation System Measured Flow Rates *(M1505.4 IRC-WA)*

The Whole House Ventilation (WHV) system operation and maintenance (O&M) instructions were provided to the building owner? Y or N (circle one)

Provided to: _____ on _____ (date)

Are the system controls correctly labelled? Y or N (circle one)

WHV System Type: (circle one)

(1) Whole House Exhaust Fan Operating Continuous

(2) Whole House Exhaust Fan Operating Intermittently

Specify run-time: _____ hours/day

(3) Balance Heat Recovery Ventilator Operating Continuous

(4) Balance Heat Recovery Ventilator Operating Intermittently

Specify run-time: _____ hours/day

(5) Supply or HRV WHV integral to the air handler. Describe system control sequence of operations: _____

_____

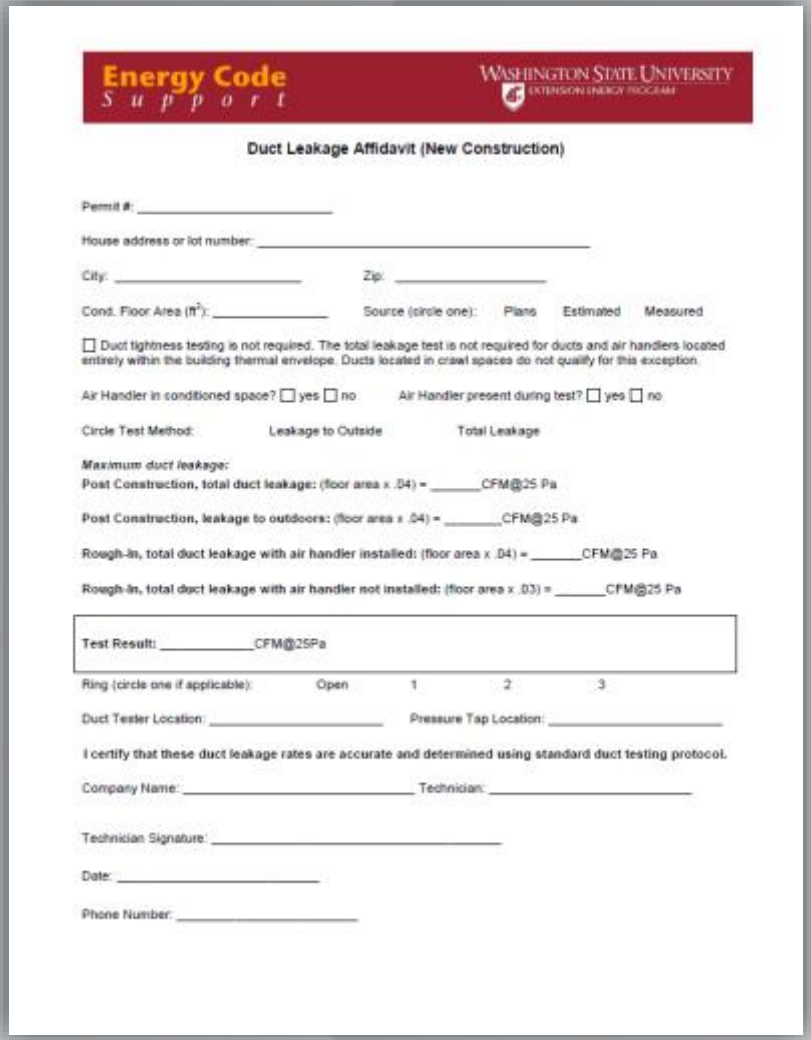
WHV Calculated Design Minimum Flow Rate: _____ cfm

WHV Measured Minimum Flow Rate: _____ cfm

WHV Measured High Speed Flow Rate: _____ cfm

Do Measured Flow Rate Test Results include GPS & Time Stamp Verification? Y or N (circle one)

Testing Affidavits & Resources



Energy Code Support

Washington State University Extension Energy Program

Duct Leakage Affidavit (New Construction)

Permit #: _____

House address or lot number: _____

City: _____ Zip: _____

Cond. Floor Area (ft²): _____ Source (circle one): Plans Estimated Measured

☐ Duct tightness testing is not required. The total leakage test is not required for ducts and air handlers located entirely within the building thermal envelope. Ducts located in crawl spaces do not qualify for this exception.

Air Handler in conditioned space? ☐ yes ☐ no Air Handler present during test? ☐ yes ☐ no

Circle Test Method: Leakage to Outside Total Leakage

Maximum duct leakage:

Post Construction, total duct leakage: (floor area x .04) = _____CFM@25 Pa

Post Construction, leakage to outdoors: (floor area x .04) = _____CFM@25 Pa

Rough-In, total duct leakage with air handler installed: (floor area x .04) = _____CFM@25 Pa

Rough-In, total duct leakage with air handler not installed: (floor area x .03) = _____CFM@25 Pa

Test Result: _____CFM@25Pa

Ring (circle one if applicable): Open 1 2 3

Duct Tester Location: _____ Pressure Tap Location: _____

I certify that these duct leakage rates are accurate and determined using standard duct testing protocol.

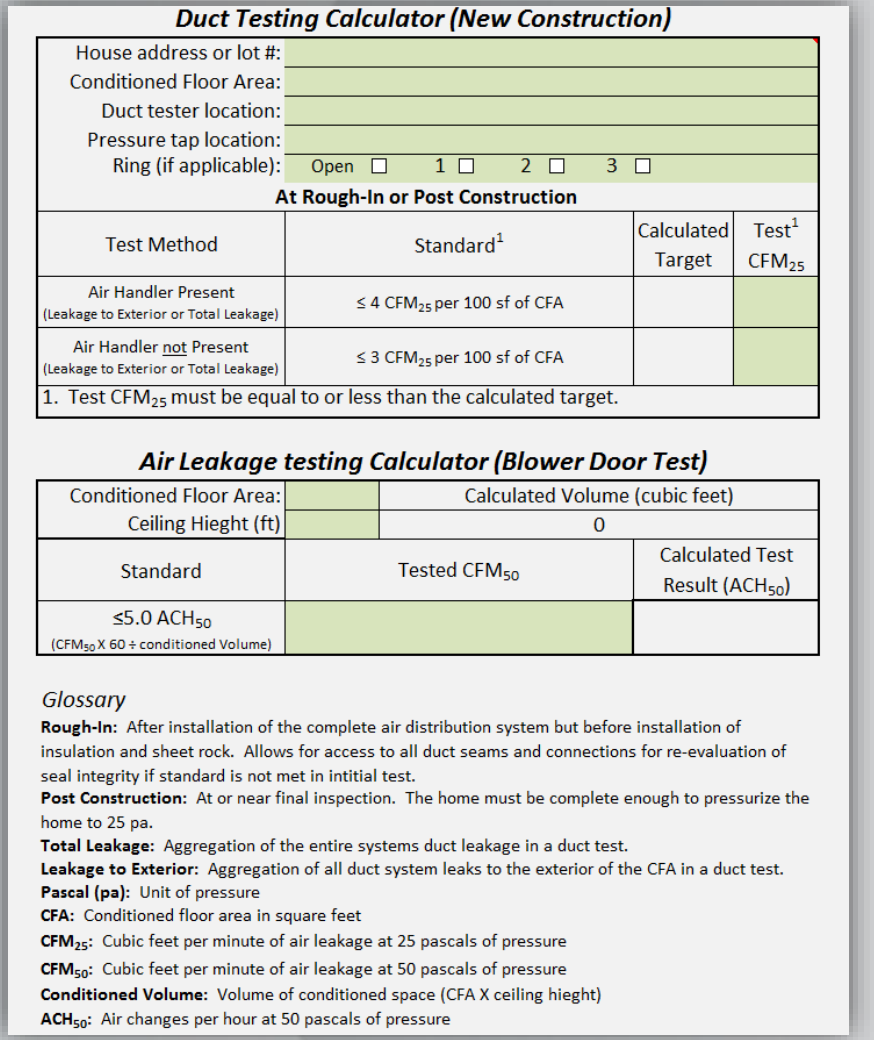
Company Name: _____ Technician: _____

Technician Signature: _____

Date: _____

Phone Number: _____

Duct Testing Affidavit
(new & existing)



Duct Testing Calculator (New Construction)

House address or lot #:	
Conditioned Floor Area:	
Duct tester location:	
Pressure tap location:	
Ring (if applicable):	Open ☐ 1 ☐ 2 ☐ 3 ☐

At Rough-In or Post Construction

Test Method	Standard[1]	Calculated Target	Test[1] CFM_{25}
Air Handler Present (Leakage to Exterior or Total Leakage)	≤ 4 CFM_{25} per 100 sf of CFA		
Air Handler not Present (Leakage to Exterior or Total Leakage)	≤ 3 CFM_{25} per 100 sf of CFA		

1. Test CFM_{25} must be equal to or less than the calculated target.

Air Leakage testing Calculator (Blower Door Test)

Conditioned Floor Area:		Calculated Volume (cubic feet)
Ceiling Hieght (ft)		0
Standard	Tested CFM_{50}	Calculated Test Result (ACH_{50})
≤5.0 ACH_{50} (CFM_{50} X 60 ÷ conditioned Volume)		

Glossary

Rough-In: After installation of the complete air distribution system but before installation of insulation and sheet rock. Allows for access to all duct seams and connections for re-evaluation of seal integrity if standard is not met in intitial test.

Post Construction: At or near final inspection. The home must be complete enough to pressurize the home to 25 pa.

Total Leakage: Aggregation of the entire systems duct leakage in a duct test.

Leakage to Exterior: Aggregation of all duct system leaks to the exterior of the CFA in a duct test.

Pascal (pa): Unit of pressure

CFA: Conditioned floor area in square feet

CFM_{25}: Cubic feet per minute of air leakage at 25 pascals of pressure

CFM_{50}: Cubic feet per minute of air leakage at 50 pascals of pressure

Conditioned Volume: Volume of conditioned space (CFA X ceiling hieght)

ACH_{50}: Air changes per hour at 50 pascals of pressure

Test Result Calculator

Why Do We Seal Ducts?

- Health and safety
- Comfort
- Energy savings
- Building durability

Duct Testing Standards

- Total leakage ≤ 4 cfm per 100 sf of conditioned floor area @ 25 Pa for a complete system at rough-in
- Total leakage ≤ 3 cfm per 100 sf of conditioned floor area @ 25 Pa if air handler *has not been* installed
- Total leakage test: ≤ 4 cfm per 100 sf of conditioned floor area @ 25 Pa at post construction
- Leakage to exterior test: ≤ 4 cfm per 100 sf of conditioned floor area @ 25 Pa - duct tester & blower door used together to eliminate leakage of ducts "inside" at post construction

Duct Sealants

All joints, seams and connections shall be fastened and sealed

- See IMC 603.9 or IRC M1601.3 for details
- Closure systems must be installed according to the manufacturer's listing
- Unlisted duct tape is not permitted as a sealant on any metal ducts

Duct Sealants

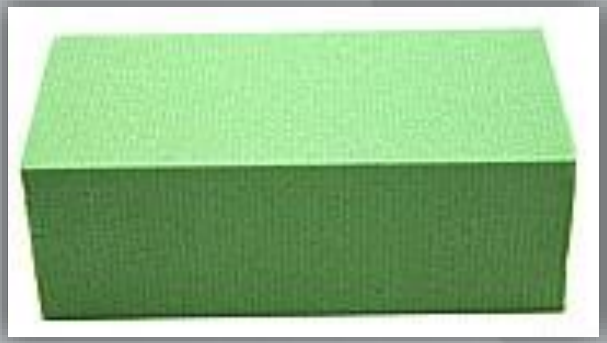
All joints, seams and connections shall be fastened and sealed

- See IMC 603.9 or IRC M1601.3 for details
- Closure systems must be installed according to the manufacturer's listing
- Unlisted duct tape is not permitted as a sealant on any metal ducts

Necessary Equipment

- Duct tester
- Manometer
- Register blocks or “mask”

fan & rings



Duct Testing (R403.3.3)

- Duct testing not required when ducts & air handlers are located entirely within the building's thermal envelope
- A maximum of 10 linear feet of return ducts and 5 linear feet of supply ducts may be located outside
- Buried ducts shall be tested to 3% of conditioned floor area (new for 2018)

R403.3.6 “Buried” Ducts

R403.3.6 Ducts buried within ceiling insulation. Where supply and return air ducts are partially or completely buried in ceiling insulation, such ducts shall comply with all of the following:

1. The supply and return ducts shall have an insulation *R*-value not less than R-8.
2. At all points along each duct, the sum of the ceiling insulation *R*-value against and above the top of the duct, and against and below the bottom of the duct, shall be not less than R-19, excluding the *R*-value of the duct insulation.

   Exception: Sections of the supply duct that are less than 3 feet (914 mm) from the supply outlet shall not be required to comply with these requirements.

R403.3.6.1 Effective *R*-value of deeply buried ducts. Where using a simulated energy performance analysis, sections of ducts that are: installed in accordance with Section R403.3.6; located directly on, or within 5.5 inches (140 mm) of the ceiling; surrounded with blown-in attic insulation having an *R*-value of R-30 or greater and located such that the top of the duct is not less than 3.5 inches (89 mm) below the top of the insulation, shall be considered as having an effective duct insulation *R*-value of R-25.

https://basc.pnnl.gov/sites/default/files/presentations/Training%20Presentation.pdf

HVAC in the Conditioned Space "Change"

- Moves HVAC into conditioned space & NOT crawlspace, garage or attic
- By far the most cost-effective measure and largely avoided until 2020
- Requires design planning between builder, HVAC sub and floor plan designer
- Don't drive an expensive box "on flat tires." Just do it!

R403.3.7 Locating Ducts in Conditioned Space

R403.3.7 Ducts located in conditioned space. For ducts to be considered as inside a conditioned space, such ducts shall comply with either of the following:

1. All duct systems shall be located completely within the continuous air barrier and within the building thermal envelope.
2. All heating, cooling and ventilation system components shall be installed inside the conditioned space including, but not limited to, forced air ducts, hydronic piping, hydronic floor heating loops, convectors and radiators. Combustion equipment shall be direct vent or sealed combustion.
3. For forced air ducts, a maximum of 10 linear feet of return ducts and 5 linear feet of supply ducts is permitted to be located outside the conditioned space, provided they are insulated to a minimum of R-8.
   - 3.1. Metallic ducts located outside the conditioned space must have both transverse and longitudinal joints sealed with mastic.
   - 3.2. 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.

Why HVAC in the Conditioned Space

HVAC in conditioned space,
NOT crawlspace, garage or attic

- Fewer, smaller “right-sized” ducts & S/R registers
- Install conducive to good installation & QA
- Fewer comfort issues from cold air blasts
- Download and review article from Energy Program web page

Moving Ducts Inside: Big Builders, Scientists Find Common Ground

Michael Lubliner, Washington State University Extension Energy Program
Ryan Kerr, ConSol/BIRA
Andy Gordon, Washington State University Extension Energy Program
Chuck Murray, Washington State Dept. of Community Trade and Economic Development

"Hot Topic" Archives

ACEEE Ducts Inside

How to Move Ducts Inside - Just do it, or spend more $

Figure 1. Habitat for Humanity, Moses Lake - Duct Chase Pre- and Post-Drywall

Figure 6. Quadrant Homes – 2nd Floor Mechanical Room, Code (Left), Energy Star/Tax Credit (Right)

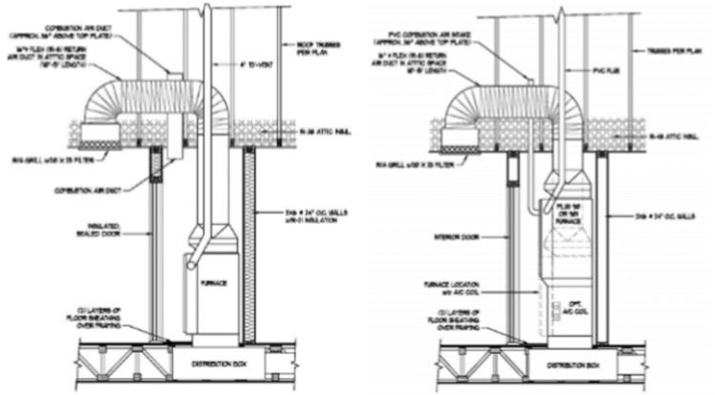


Figure 5. New Tradition Homes – Air Handler in Conditioned Space, under Stairwell

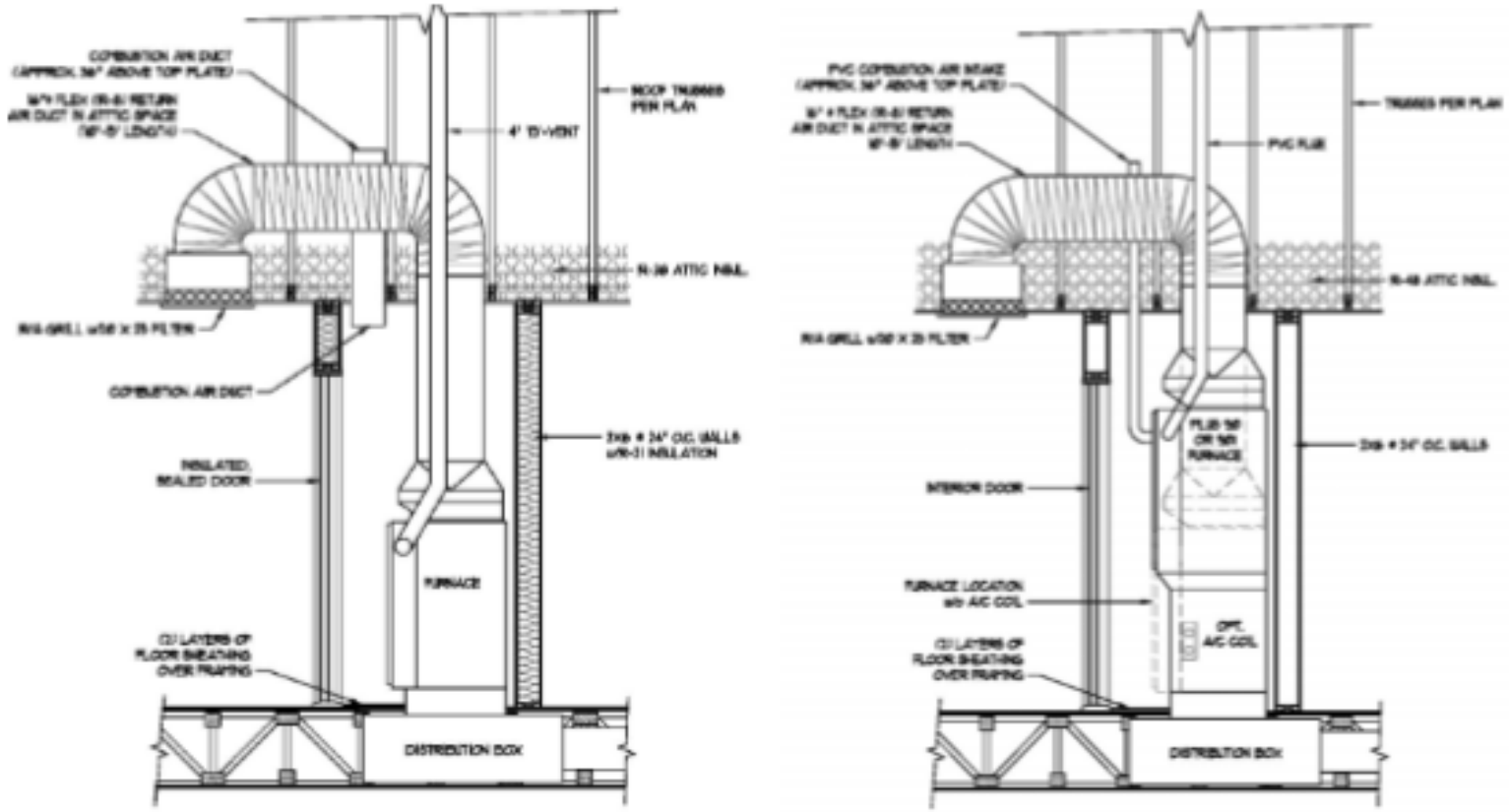
Figure 3. New Tradition Homes – Ducts Between Floors, Pre- and Post-Drywall

HVAC Inside Ideas – Habitat for Humanity

Figure 1. Habitat for Humanity, Moses Lake - Duct Chase Pre- and Post-Drywall

HVAC Inside Ideas - Quadrant

Figure 6. Quadrant Homes – 2nd Floor Mechanical Room, Code (Left), Energy Star/Tax Credit (Right)



Source: Quadrant Homes

HVAC Inside Ideas – New Tradition Homes

Figure 3. New Tradition Homes – Ducts Between Floors, Pre- and Post-Drywall

Figure 5. New Tradition Homes – Air Handler in Conditioned Space, under Stairwell

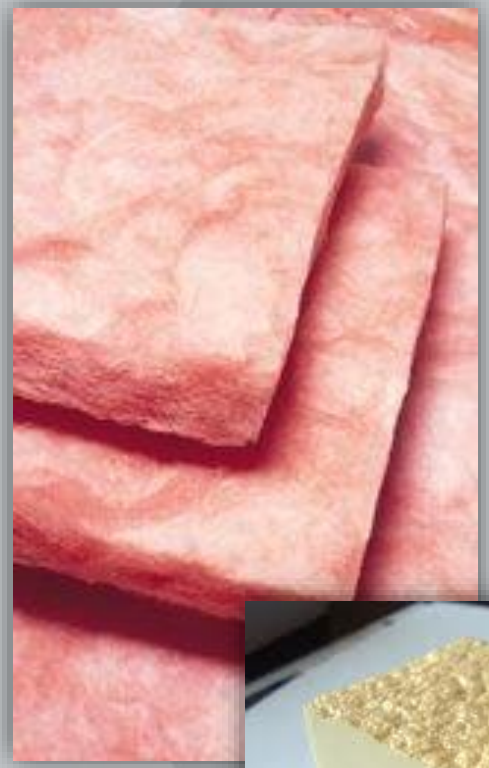
Air Barriers and Energy Code R402.4

What does the Energy Code require?

- Prescriptive air sealing
- Testing of the air barrier
- Maximum leakage targets
  - 2015 WSEC maximum = 5 ACH_{50} New/Additions
  - 2018 may need 0.5 credit for 3 ACH_{50}
  - 2018 may want 2.0 ACH_{50} w/HRV or ERV 2020 for 1.5 - 2.0 credits

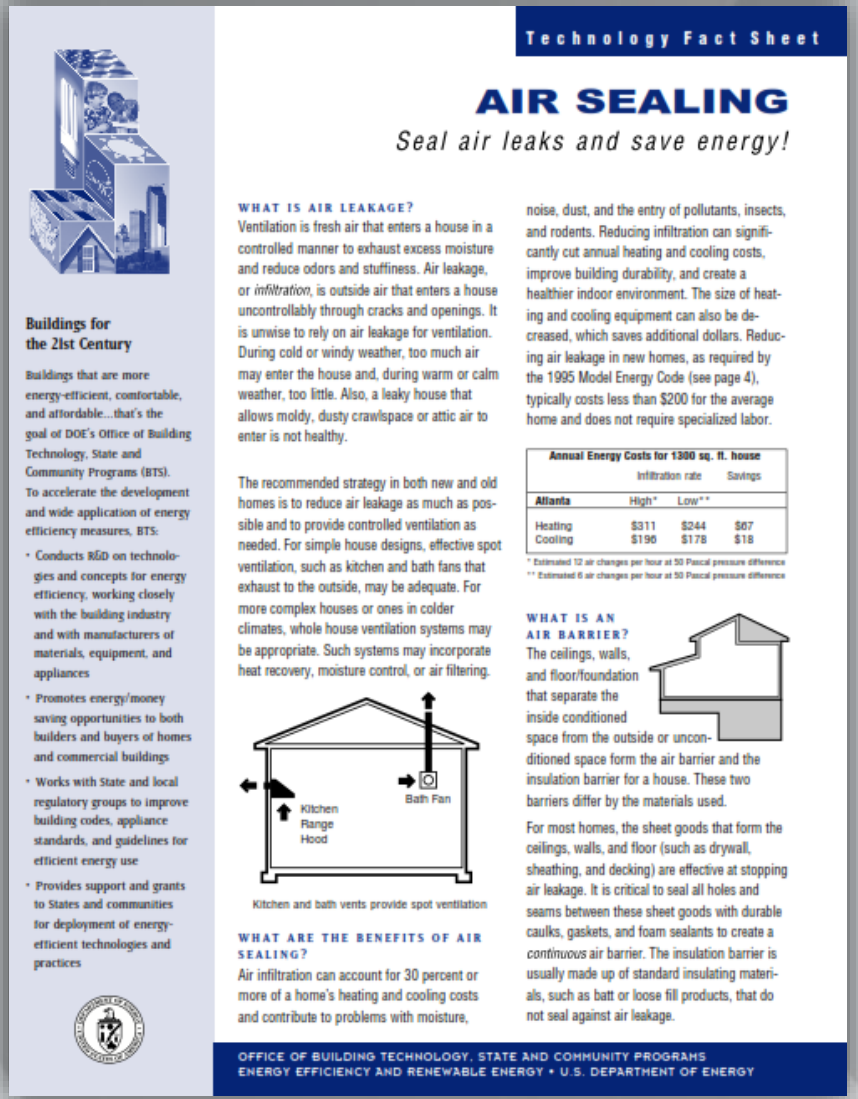
Table R402.4.1.1
Air Barrier and Thermal Barrier

- ✓ Building envelope must have continuous air barrier
- ✓ Breaks or joints are sealed
- ✓ Air-permeable insulation is not an air barrier



VS.

QA Tools for New Construction
Maximum Leakage = 5 ACH_{50}



Technology Fact Sheet

AIR SEALING

Seal air leaks and save energy!

Buildings for the 21st Century

Buildings that are more energy-efficient, comfortable, and affordable...that's the goal of DOE's Office of Building Technology, State and Community Programs (BTS). To accelerate the development and wide application of energy efficiency measures, BTS:

- Conducts R&D on technologies and concepts for energy efficiency, working closely with the building industry and with manufacturers of materials, equipment, and appliances
- Promotes energy/money saving opportunities to both builders and buyers of homes and commercial buildings
- Works with State and local regulatory groups to improve building codes, appliance standards, and guidelines for efficient energy use
- Provides support and grants to States and communities for deployment of energy-efficient technologies and practices

WHAT IS AIR LEAKAGE?

Ventilation is fresh air that enters a house in a controlled manner to exhaust excess moisture and reduce odors and stuffiness. Air leakage, or *infiltration*, is outside air that enters a house uncontrollably through cracks and openings. It is unwise to rely on air leakage for ventilation. During cold or windy weather, too much air may enter the house and, during warm or calm weather, too little. Also, a leaky house that allows moldy, dusty crawlspace or attic air to enter is not healthy.

The recommended strategy in both new and old homes is to reduce air leakage as much as possible and to provide controlled ventilation as needed. For simple house designs, effective spot ventilation, such as kitchen and bath fans that exhaust to the outside, may be adequate. For more complex houses or ones in colder climates, whole house ventilation systems may be appropriate. Such systems may incorporate heat recovery, moisture control, or air filtering.

Kitchen and bath vents provide spot ventilation

WHAT ARE THE BENEFITS OF AIR SEALING?

Air infiltration can account for 30 percent or more of a home's heating and cooling costs and contribute to problems with moisture, noise, dust, and the entry of pollutants, insects, and rodents. Reducing infiltration can significantly cut annual heating and cooling costs, improve building durability, and create a healthier indoor environment. The size of heating and cooling equipment can also be decreased, which saves additional dollars. Reducing air leakage in new homes, as required by the 1995 Model Energy Code (see page 4), typically costs less than $200 for the average home and does not require specialized labor.

Annual Energy Costs for 1300 sq. ft. house

	Infiltration rate		Savings
Atlanta	High*	Low**	
Heating	$311	$244	$67
Cooling	$196	$178	$18

* Estimated 12 air changes per hour at 50 Pascal pressure difference
** Estimated 6 air changes per hour at 50 Pascal pressure difference

WHAT IS AN AIR BARRIER?

The ceilings, walls, and floor/foundation that separate the inside conditioned space from the outside or unconditioned space form the air barrier and the insulation barrier for a house. These two barriers differ by the materials used.

For most homes, the sheet goods that form the ceilings, walls, and floor (such as drywall, sheathing, and decking) are effective at stopping air leakage. It is critical to seal all holes and seams between these sheet goods with durable caulks, gaskets, and foam sealants to create a *continuous* air barrier. The insulation barrier is usually made up of standard insulating materials, such as batt or loose fill products, that do not seal against air leakage.

OFFICE OF BUILDING TECHNOLOGY, STATE AND COMMUNITY PROGRAMS
ENERGY EFFICIENCY AND RENEWABLE ENERGY • U.S. DEPARTMENT OF ENERGY

WSU Video Resource
"Built Tight, Ventilate Right"

Duct Sealing for Comfort, Energy and Air Quality

http://www.energy.wsu.edu/videos/duct-sealing/

Sealing HVAC system ducts is a cost-effective energy efficiency action that also improves indoor air quality. Building professionals and homeowners will learn how ducts move air, where common leaks are, and how to fix leaks.

WSU Video Resource "Build Tight"

Air Leakage in Homes: The Invisible Thief

http://www.energy.wsu.edu/videos/air-leakage-in-homes_part-01/

(presented in 7 chapters)

WSU Video Resource “Ventilate Right”

Fresh Air for a Healthier Home

The consumer's guide to ventilation systems

Part 1: Why Ventilate?

R402.4.2.1 Gas Fireplace Efficiency 50% FE for Heaters (new)

R402.4.2.1 Gas fireplace efficiency. All gas fireplace heaters rated to ANSI Z21.88 shall be listed and labeled with a fireplace efficiency (FE) rating of 50 percent or greater in accordance with CSA P.4.1. Vented gas fireplaces (decorative appliances) certified to ANSI Z21.50 shall be listed and labeled, including their FE ratings, in accordance with CSA P.4.1.

R403.7.1 Electric Resistance Zone Heated Units – since 2015

All detached one- and two-family dwellings and multiple single-family dwellings (townhouses) up to three stories in height above grade plane using electric zonal heating as the primary heat source shall install an inverter-driven ductless mini-split heat pump in the largest zone in the dwelling.*

* Does <u>not</u> apply to R-2 construction

1.5 - 2.0 credits allowed from options package 3.6 for single family and multifamily, respectively (increase credits from 2015)

Join our email update list at
energycode@energy.wsu.edu

Send questions, comments and suggestions to:

Michael Lubliner

360-956-2042

energycode@energy.wsu.edu

Thank You!