



WASHINGTON STATE UNIVERSITY
Energy Program

WSEC-R 2021

A two hour education & update
covering the EPCA CR-103

Washington State University
Energy Program

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>)



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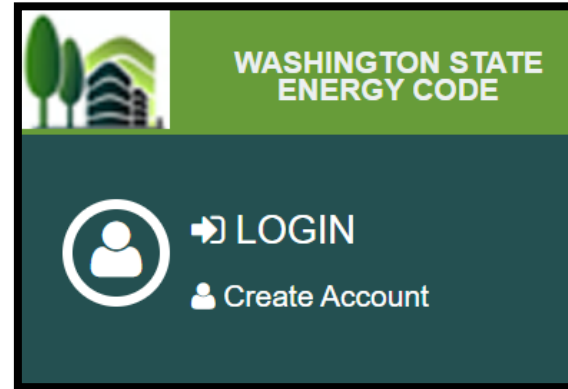
This presentation's purpose is to guide the perspective viewer through a summary review of the WSEC-R & WSEC-R 2021 code update. This education is an estimated two hour class.

Introduction to WSU-Energy Program & ECC Trainings

1. SBCC & WA State Code Process
2. WSEC-R Chapters
 1. Scope & Administration
 2. Definitions
 3. General Requirements
 4. Residential Energy Efficiency
 5. Existing Buildings
3. Additional Resources

Conclusion & Questions

Washington State Energy Code Support?



Residential

[WSU Energy Program](#)

energycode@energy.wsu.edu

360-956-2042

Commercial

[Evergreen Technology Consulting](#)

com.techsupport@waenergycodes.com

360-539-5202

Energy Code Support?

- Email
- Hotline



Website:
www.energy.wsu.edu/buildingefficiency/energycode.aspx



- Forms
- Online Educations
- Video



- FAQ's
- Resource Links
- Training Partners

The WSU (Washington State University) Energy Program has a long history of working towards energy efficiency, renewable energy, and sustainable practices. Here is an overview of its history:

Establishment: The WSU Energy Program was established in 1996 as part of the Washington State University Extension. It was initially known as the Washington Energy Extension Service.

Early Focus: In its early years, the program primarily focused on energy conservation and efficiency. It aimed to educate and provide technical assistance to individuals, businesses, and communities in Washington State to promote energy conservation practices.

Growth and Diversification: Over time, the program expanded its scope and initiatives. It began to work on a broader range of energy-related issues, including renewable energy, clean technologies, and sustainable practices. The program became involved in research, development, and deployment of new energy technologies.

Federal Programs and Partnerships: The WSU Energy Program has actively collaborated with federal agencies, including the U.S. Department of Energy (DOE), the U.S. Environmental Protection Agency (EPA), and the U.S. Department of Agriculture (USDA). These partnerships allowed the program to access resources, funding, and expertise to further its mission.

Energy Codes and Standards: The WSU Energy Program played a significant role in the development and implementation of energy codes and standards in Washington State. It worked closely with government agencies, utility companies, and industry stakeholders to establish energy efficiency requirements for buildings and appliances.

Renewable Energy Initiatives: The program has been involved in various renewable energy initiatives, such as solar power, wind energy, bioenergy, and energy storage. It has supported research, demonstration projects, and educational efforts to promote the adoption of renewable energy technologies.

Education and Training: The WSU Energy Program has been actively engaged in providing education and training to professionals, students, and the general public. It offers workshops, seminars, and certification programs on energy efficiency, renewable energy, and sustainable practices.

Focus on Communities: The program has a strong focus on serving communities throughout Washington State. It provides technical assistance, funding support, and resources to help communities develop sustainable energy plans, implement energy projects, and reduce energy consumption.

Continued Innovation: The WSU Energy Program continues to evolve and adapt to changing energy landscapes and emerging technologies. It stays at the forefront of energy research, policy development, and industry trends to address current and future energy challenges.

Overall, the WSU Energy Program has a rich history of promoting energy efficiency, renewable energy, and sustainable practices. Its work has contributed to the advancement of clean energy technologies and the reduction of energy consumption in Washington State and beyond.

WHAT?

The School of Design and Construction's Energy Conscious Construction (ECC) Certificates are a set of interdisciplinary educational programs with emphasis in high-performing energy-efficient residential buildings and covering all phases of the design process from pre-design to construction observation.

WHY?

WA Residential buildings consume 23% of all energy. Our state has one of the most progressive energy codes and is committed to reducing greenhouse gas emissions from buildings through the Climate Commitment Act.

The ECC programs prepare you for a career in building energy efficiency and address the rise in competency gaps associated with Washington's initiatives and goals for a sustainable future.

WHO?

DEGREE SEEKING: Open to current students in the Voland College of Engineering and Architecture, specifically **undergraduate** students at the junior level as well as **graduate** students.

NON-DEGREE SEEKING: Open to non-degree seeking students from outside WSU with backgrounds in design, construction, and engineering disciplines.



UNDERGRADUATE

ONLINE CERTIFICATE | 15 CREDITS

COURSES	CREDITS
ME 483 Fund. of Bldg. Sci.	3
SDC 451 Energy Modeling I	3
SDC 441 Bldg. Energy Codes	3
ARCH 464 Advanced Res. Const. OR	3
ARCH 495 Modular Off-Site Const.	
ARCH 493 Environmental Cont. Sys. I	3

GRADUATE

ONLINE CERTIFICATE | 12 CREDITS

COURSES	CREDITS
ME 579 Advanced Topics	3
SDC 552 Energy Modeling II	3
SDC 541 Bldg. Energy Codes	3
ARCH 531 Advanced Tectonics	3

COMPETENCY

GAPS COVERED IN THE CURRICULUM



Energy Modeling



Assemblies & Structures



Environmental Cont. Sys.



Performance Benchmarks

YOU can create and design an energy-efficient built environment using the knowledge and skills ECC provides.



SDC.INFO@WSU.EDU
(509) 335-5539
HTTPS://SDC.WSU.EDU/



WASHINGTON STATE UNIVERSITY
School of Design and Construction

WHAT IS ECC?

The School of Design and Construction's programs in Energy Conscious Construction (ECC) is nationally recognized by the U.S. Department of Energy's Zero Energy Design Designation. This recognition ensures that the ECC provides students with a solid foundation in building science and the opportunity to apply that knowledge in the design process through its various assessment methods. The ECC offers an interdisciplinary emphasis in energy-efficient residential buildings, with a focus on the state of Washington and covering all phases of the design process from design through construction and post occupancy evaluation.

WSEC-R 2021

EPCA CR103 Edition

Two Hour Education & Update

Join WSU-EP as we cover the new 2021 Washington State Energy Code Residential proposed changes (EPCA-CR103) that will be released in **March of 2024**.

Our presentation will contain both beginner & intermediate level education/update on the WSEC-R. This education will be available virtually on the second Wednesday of each month. Visit our training page to register.



WASHINGTON STATE UNIVERSITY
Energy Program



2023 Trainings

The new WSEC-R website is currently under construction. Thank you for your patience as things are relocated on the website during this time. We are excited as these changes to the website will allow for new features and tools that will help us to better service you, our clients.

<https://www.energy.wsu.edu/EventsTrainings.aspx>



Photo courtesy of:

[About SBCC | SBCC \(wa.gov\)](https://www.wa.gov/sbcc)

State Building Code Council (SBCC)

What is the SBCC & what do they do?

The State Building Code Council (SBCC) was created to provide independent analysis and objective advice to the legislature and the Governor's Office on state building code issues. The SBCC establishes the minimum building, mechanical, fire, plumbing and energy code requirements necessary to promote the health, safety and welfare of the people of the state of Washington by reviewing, developing and adopting the state building code.

The SBCC is formed by RCW 19.27.070 and its membership consists of fifteen members:

- Two members must be county elected legislative body members or elected executives.
- Two members must be city elected legislative body members or mayors.
- One member must be a local government building code enforcement official.
- One member must be a local government fire service official.
- One member must be a person with a physical disability and shall represent the disability community.
- One member, who is not eligible for membership on the council in any other capacity, and who has not previously been nominated or appointed to the council to represent any other group, must represent the general public.
- Seven members must represent the private sector or professional organizations as follows:
 - One member shall represent general construction, specializing in commercial and industrial building construction.
 - One member shall represent general construction, specializing in residential and multifamily building construction.
 - One member shall represent the architectural design profession; (iv) One member shall represent the structural engineering profession.
 - One member shall represent the mechanical engineering profession.
 - One member shall represent the construction building trades.
 - One member shall represent manufacturers, installers, or suppliers of building materials and components.
- At least six of these fifteen members shall reside east of the crest of the Cascade mountains.

REVISED EFFECTIVE DATE FOR 2021 CODES

MARCH 15, 2024

The State Building Code Council voted on May 24, 2023, to delay the effective date of the 2021 codes for 120 days, which changed the effective date from July 1, 2023 to October 29, 2023. On September 15, 2023, the State Building Code Council agreed on another delay. The new effective date for all building codes is March 15, 2024.

The Council is also entering rulemaking to modify sections in the commercial and residential energy codes to address legal uncertainty stemming from the decision in California Restaurant Association v. City of Berkeley recently issued by the Ninth Circuit Court of Appeals.

Information on SBCC and related documents are courtesy of:

[The State Building Code Council](#)

Adopted Changes to the Energy Code for EPCA Concerns

On November 28, the Washington State Building Code Council adopted changes for WAC 51-11C Washington State Energy Code - Commercial Provisions and WAC 51-11R, Washington State Energy Code - Residential Provisions, and directed staff to prepare the CR103 forms. These changes will become effective with the 2021 Washington State Energy Code on March 15, 2024. The CR103 forms are anticipated to be filed at the end of the month. Please see the draft of the adopted changes here:

Washington State Energy Code - [Commercial Provisions](#)

Washington State Energy Code - [Residential Provisions](#)

Information on the [CR103](#)
and related documents are
courtesy of: SBCC:

<https://www.sbcc.wa.gov/news/adopted-changes-energy-code-ezca-concerns>

A screenshot of a news article titled "Building Code News" from the SBCC website. The article discusses the adoption and amendment of the 2021 Washington State Energy Code for Residential Provisions. It includes details about the effective date (March 15, 2024) and the scope of the code for residential buildings. The article is dated December 05, 2023.

Building Code News

Chapter 51-11R WAC
STATE BUILDING CODE ADOPTION AND AMENDMENT OF THE ((2014)) 2021
EDITION OF THE INTERNATIONAL ENERGY CONSERVATION CODE, RESIDENTIAL

AMENDATORY SECTION (Amending WSR 23-02-060, 23-12-102, and 23-20-022, filed 1/3/23, 6/7/23, and 9/25/23, effective 3/15/24)

WAC 51-11R-10100 Section R101—Scope and general requirements.

R101.1 Title. This code shall be known as the *Washington State Energy Code-Residential*, and shall be cited as such. It is referred to herein as "this code."

The 2021 edition of the *Washington State Energy Code* is hereby adopted. The *Washington State Energy Code* adopted under chapter 51-11R WAC shall become effective in all counties and cities of this state on ((July 1, 2023)) **March 15, 2024**.

R101.2 Scope. This code applies to *residential buildings* and the buildings sites and associated systems and equipment. This code shall be the maximum and minimum energy code for residential construction in each town, city and county. Residential *sleeping units*, Group I-1, Condition 2 assisted living facilities licensed by Washington state under chapter 388-78A WAC and Group I-1, Condition 2 residential treatment facilities licensed by Washington state under chapter 246-337 WAC shall utilize the commercial building sections of the energy code regardless of the number of stories of height above grade plane.

R101.3 Intent. This code shall regulate the design and construction of buildings for the effective use and conservation of energy over the useful life of each building. This code is intended to provide flexibility to permit the use of innovative approaches and techniques to achieve this objective. This code is not intended to abridge

Dec 05, 2023
Code for EPCA Concerns

Nov 29, 2023
Proposed Changes

Nov 27, 2023
Proposed Changes

Oct 19, 2023
Energy Code Council

Sep 21, 2023
Energy Code Council

Legend



Testing



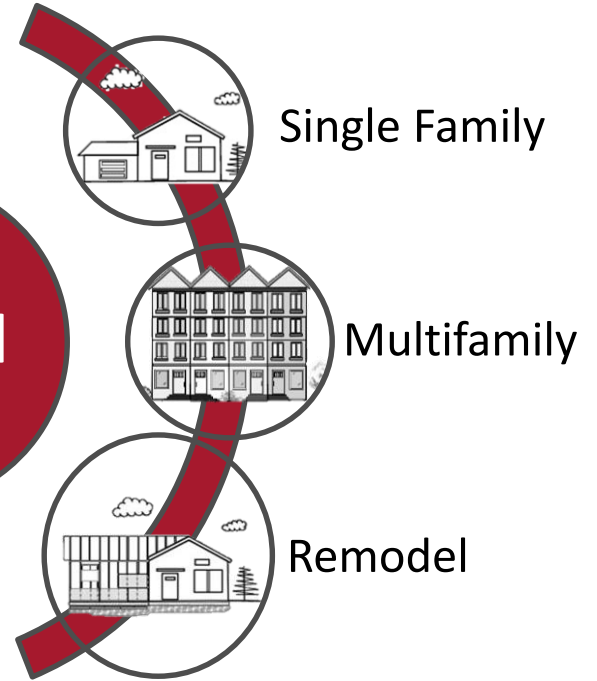
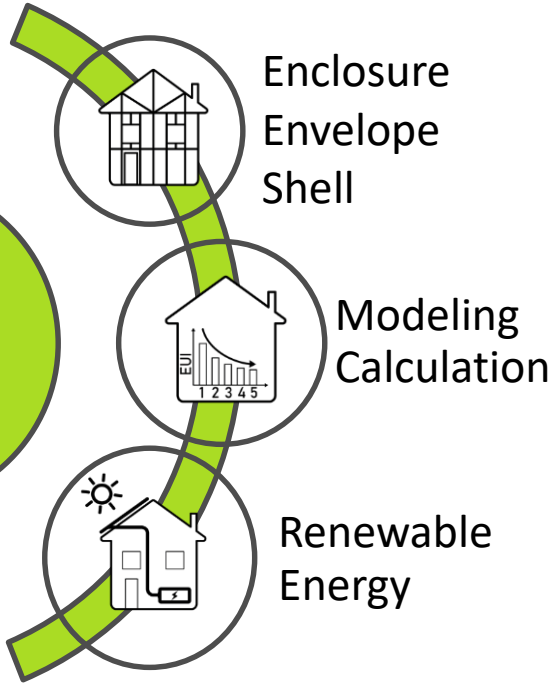
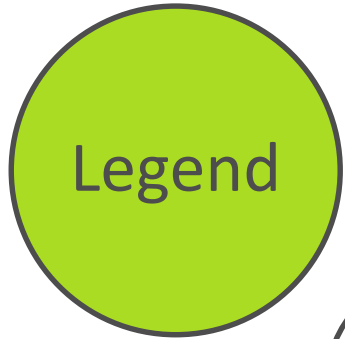
Controls
Settings



Heating
Cooling
Ventilation



Administration
Prescriptive



What is Chapter 1?

Chapter 1 is Scope and Administration, “Office stuff”.

Key (new & existing) points in Chapter 1 for the purposes of this education. Chapter 1 covers the administrative practice such as permitting, fee, work orders, process (inspections and enforcement).

- Defines what types of projects shall comply with this code -**R101.2**
 - Mixed use must be separately considered - **R101.4.1**
- New “lingo” for digital submittal for permits - **R103.1**
- Required documentation for the permit process - **R103.2**

- Also Defines the minimum requirements of:
- Documentation retention time - **R103.5,**
 - Fee’s - **R104’s,**
 - Inspections - **R105’s,**
 - Approval and Standards - **R106 – R108’s**
 - Additional Administrative Functions - **R109 - R112’s**



R103.2 Information on construction documents. Construction documents shall be drawn to scale upon suitable material. Electronic media documents are permitted to be submitted when approved by the code official. Construction documents shall be of sufficient clarity to indicate the location, nature and extent of the work proposed, and show in sufficient detail pertinent data and features of the building, systems and equipment as herein governed.

1. Energy compliance path per Section R401.2.
2. Insulation materials and their R-values.
3. Fenestration U-factors and SHGCs.
4. Area-weighted U-factor and SHGC calculations.
5. Mechanical system design criteria.
6. Mechanical and service water heating system and equipment types, sizes and efficiencies.
7. Equipment and systems controls.
8. Duct sealing, duct and pipe insulation and location.
9. Air sealing details.

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

Summary of Chapter 1
WSEC - Residential 2021
EPCA Edition:



- ✓ Additional language that enforces the use of digital permitting.
- ✓ R-2 designated projects that are corridor loaded will now be required to comply with the WSEC-C (commercial).
- ✓ Alignment to national code sections
- ✓ List of everything that needs to be included for a permit.

What is Chapter 2?

Chapter 2 is Definitions, “Geeky stuff”.

Key (new & existing) points in Chapter 2 for the purposes of this education.

Chapter 2 consists of definitions as they apply to the WSEC-R

- U-Factor/F-Factor
- Whole House Mechanical System
- Zone
- Residential Building
- Renewable Energy Certificate
- Renewable Energy Resources
- Ready access to

- Advanced Framed Walls
- Air Barrier
- Vapor Barrier
- Building Thermal Envelope
- Continuous insulation (CI)
- Dwelling Unit Enclosure Area

Chapter 2

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.

DWELLING UNIT ENCLOSURE AREA. The sum of the area of ceiling, floors and walls separating a dwelling unit's conditioned space from the exterior or from adjacent conditioned or unconditioned spaces. Wall height shall be measured from the finished floor of the dwelling unit to the underside of the floor above.

Chapter 2

RENEWABLE ENERGY CERTIFICATE (REC).

An instrument that represents the environmental attributes of one megawatt hour of renewable energy; also known as an energy attribute certificate (EAC).

RENEWABLE ENERGY RESOURCES.

Energy derived from solar radiation, wind, waves, tides, landfill gas, biogas, biomass or extracted from hot fluid or steam heated within the earth.



2021 International Residential Code (IRC)

Significant Changes: Electric Vehicle Charging

BEGINNING JULY 1, 2023

New construction projects which create dwelling units *and* include an attached garage or attached carport will now need to **provide one 40-amp dedicated 208/240-volt branch circuit** for each dwelling unit, intended for future electric vehicle charging. This circuit may terminate in electric vehicle charging equipment; however, a junction box or receptacle outlet is also acceptable.



For full code text, see 2021 IRC Section [R309.6](#) (WA Amendment)



Figure 1 Electrical panel image. Source: [How to Install a 240-Volt Circuit Breaker](#) (thespruce.com)

While electric vehicles can be charged by a standard household outlet (120-volt), this "Level 1 Charging" provides about 2-5 miles of range per hour, so a full charge can take up to 24 hours. The 240-volt circuit will allow for faster charging, known as "Level 2 Charging". Level 2 charging provides about 10-25 miles of range per hour, so a full charge can take as little as 3-10 hours. For the average driver, Level 2 charging will allow them to fully charge overnight.

Installing the capability for Level 2 charging at the time of initial construction is a cost-effective way to prepare a home to be ready for an electric vehicle. This type of circuit is the same type of wiring as an electric stove or clothes dryer and can easily be installed by a professional electrician.

FAQ courtesy of: [King County](#)

Summary of Chapter 2
WSEC - Residential 2021
EPCA Edition:



- ✓ Definition of Residential Buildings moving R-2 designated projects that are corridor loaded will now be required to comply with the WSEC-C (commercial).
- ✓ REC/EAC credits
- ✓ Approved Agency
- ✓ New or altered definitions worth reading.

What is Chapter 3?

Chapter 3 is General Requirements, “Important, where else would it go?”.

This chapter covers design, defaults/set points and labeling/reporting specification requirements for the WSEC-R

Key (new & existing) points in Chapter 3 for the purposes of this education.

Defines climate zones for every city in WA state - **R301.1**

Defines design conditions (think Manual J) - **R302.1 & R302.2**

Materials, Systems & Equipment - **R303**

Identification & Labeling - **303.1.**

Default exception - **R303.1.1.1**

Fenestration Rating Req. (NFRC) - **R303.1.3**

Insulation product rating - **R303.1.4**

Installation of exterior insulation - **R303.2**

Maintenance Information - **R303.3**

Chapter 3

**TABLE R303.1.3(5)
SMALL BUSINESS COMPLIANCE TABLE
DEFAULT U-FACTORS FOR VERTICAL FENESTRATION**

Vertical Fenestration Description				Frame Type		
				Any Frame	Aluminum Thermal Break ^b	Wood/Vinyl/Fiberglass
Panes	Low-e ^a	Spacer	Fill			
Double ^c	A	Any	Argon	0.48	0.41	0.32
	B	Any	Argon	0.46	0.39	0.30
	C	Any	Argon	0.44	0.37	0.28
	C	High Performance	Argon	0.42	0.35	Deemed to comply ^e
Triple ^d	A	Any	Air	0.50	0.44	0.26
	B	Any	Air	0.45	0.39	0.22
	C	Any	Air	0.41	0.34	0.20
	Any double low-e	Any	Air	0.35	0.32	0.18

- a. Low-eA (emissivity) shall be 0.24 to 0.16.
Low-eB (emissivity) shall be 0.15 to 0.08.
Low-eC (emissivity) shall be 0.07 or less.
- b. Aluminum Thermal Break = An aluminum thermal break framed window shall incorporate the following minimum design characteristics:
 - 1) The thermal conductivity of the thermal break material shall be not more than 3.6 Btu-in/h/R²/F;
 - 2) The thermal break material must produce a gap in the frame material of not less than 0.210 inches; and
 - 3) All metal framing members of the products exposed to interior and exterior air shall incorporate a thermal break meeting the criteria in 1) and 2) above.
- c. A minimum air space of 0.375 inches between panes of glass is required for double glazing.
- d. A minimum air space of 0.25 inches between panes of glass is required for triple glazing.
- e. Deemed to comply glazing shall not be used for performance compliance.

**TABLE R303.1.3(4)
DEFAULT U-FACTORS FOR SKYLIGHTS**

Fenestration Type	Frame Type			
	Aluminum Without Thermal Break	Aluminum With Thermal Break	Reinforced Vinyl/Aluminum-Clad Wood or Vinyl	Wood or Vinyl-Clad Wood/Vinyl without Reinforcing
Single Glazing glass	U-1.58	U-1.51	U-1.40	U-1.18
acrylic/polycarb	U-1.52	U-1.45	U-1.34	U-1.11
Double Glazing air	U-1.05	U-0.89	U-0.84	U-0.67
argon	U-1.02	U-0.86	U-0.80	U-0.64
Double Glazing, e=0.20 air	U-0.96	U-0.80	U-0.75	U-0.59
argon	U-0.91	U-0.75	U-0.70	U-0.54
Double Glazing, e=0.10 air	U-0.94	U-0.79	U-0.74	U-0.58
argon	U-0.89	U-0.73	U-0.68	U-0.52
Double Glazing, e=0.05				

**TABLE R303.1.3(1)
DEFAULT GLAZED WINDOW, GLASS DOOR AND SKYLIGHT U-FACTOR**

FRAME TYPE	WINDOW AND GLASS DOOR		SKYLIGHT
	SINGLE PANE	DOUBLE PANE	
Metal	1.20	0.80	See Table R303.1.3(4)
Metal with Thermal Break ^a	1.10	0.65	
Nonmetal or Metal Clad	0.95	0.55	
Glazed Block	0.60		

Summary of Chapter 3
WSEC - Residential 2021
EPCA Edition:



- ✓ Standards, “Best Practices”, and Labeling
- ✓ Default fenestration requirements for doors and glazing
- ✓ Garage door labeling and reported efficiency values
- ✓ Maintenance Information
- ✓ Product Rating Requirements

What is Chapter 4?

Chapter 4 is Residential Energy Efficiencies, “The nitty gritty stuff”.

Chapter 4 is best handled when divided into each of the categories. Chapter 4 is the largest of the chapters of WSEC-R with each section referenced below.

General - R401

Building Thermal Envelope - R402

Systems - R403

Electrical Power & Lighting - R404

Total Building Performance - R405

Additional Energy Efficiency Req. - R406

Certified Passive House - R407

Scope of work, Compliance & Certification.

Chapter 4, section R401 covers the beginning of the journey by defining the administrative process and inspections.



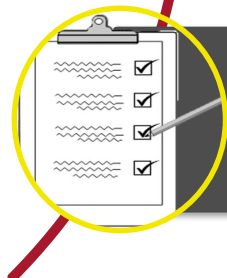
R-401.1 Scope of Work

- Moves R-2 Corridor loaded multifamily buildings to the WSEC-C (Commercial).



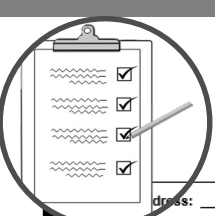
R401.2 Compliance

- This defines which parts of the WSEC-R each housing type designation shall be required to comply with.



R 401.3 Certification

- This section defines the requirement of the use of a certificate that shall be installed in the dwelling.



Chapter 4

General R401.3 - Certificate

2021 WSEC Residential Energy Compliance Certificate (Effective November 1, 2021)

Address: _____

Builder/registered design professional name: _____

Builder/reg. design pro. signature: _____

Conditioned floor area: _____ ft² (per building permit)

R-Values (R303.1.1)			
Ceiling/Attic:	Vaulted R-_____	Floors:	Over unconditioned space R-_____
	Attic R-_____		Slab-on-grade floor R-_____
Walls:	Above grade R-_____	Fully insulated slab? Y/N (Circle one)	
	Below, int. R-_____	Doors:	R-_____, R-_____, R-_____
	Below, ext. R-_____		

U-Value of Windows, Skylights and Doors (R303.1.1.3)

Average area weighted U-value from Glazing Worksheet _____ Average U- _____

Energy Equalization Credits (Tables R406.2) and Energy Credits (Table R406.3)

System Type Number (1 to 5) _____ (Select one)

Energy Credits selected (1 to 7) _____

Energy Equalization Credit _____ + Total Energy Credits _____ = Total Credits _____

Heating, Cooling and Domestic Hot Water		
System	Type (Manufacturer and Model Number)	Efficiency
Heating	(draft)	
Cooling		
DHW		
Drain water heat recovery		

Onsite Renewable Energy Electric Power System

System type _____ System design capacity _____ kW

Rated annual generation _____ kWh/yr.

Appliances		Energy Star?
Manufacturer and Model		(Circle one)
Dish washer		Y or N
Refrigerator		Y or N
Washer		Y or N
Dryer		Y or N

Vented or unvented? _____ If vented, CEF rating _____

Gas fireplace / heating stove (Section R402.4.2) _____ Fireplace efficiency (FE) _____

Heating or Decorative? (Circle one)

A permanent certificate shall be completed by the builder 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 indicate the following:

1. The predominant R-values of insulation installed in or on ceiling/roof, walls, foundation (slab, belowgrade wall, and/or floor) and ducts outside conditioned spaces.
2. U-factors for fenestration and the solar heat gain coefficient (SHGC) of fenestration. Where there is more than one value for each component, the certificate shall indicate the area weighted average value.
3. The results from any required duct system and building envelope air leakage testing done on the building.
4. The results from the whole-house mechanical ventilation system flow rate test.
5. The types, sizes and efficiencies of heating, cooling, whole-house mechanical ventilation, and service water heating appliances. Where a gas-fired unvented room heater, electric furnace, or baseboard electric heater is installed in the residence, the certificate shall list "gas-fired unvented room heater," "electric furnace" or "baseboard electric heater," as appropriate. An efficiency shall not be listed for gas-fired unvented room heaters, electric furnaces or electric baseboard heaters..
6. Where on-site photovoltaic panel systems have been installed, the array capacity, inverter efficiency, panel tilt, orientation and estimated annual electrical generation shall be noted on the certificate.
7. The code edition under which the structure was permitted, and the compliance path used.

The code official may require that documentation for any required test results include an electronic record of the time, date and location of the test. A date-stamped smart phone photo or air leakage testing software may be used to satisfy this requirement.

Summary of Chapter R401
WSEC - Residential 2021
EPCA Edition:



- ✓ Specifies the project type defining its pathway through the code
- ✓ Required pathway compliance and required pathway reporting
- ✓ Certificate “Sticker”, commonly missed item!

Building Thermal Envelope:

Chapter 4, section R402 covers key points in the Building Thermal Envelope and states the minimum envelope/shell requirements.

This is a pretty large section.

R402.1 General

- Vapor retarders - R402.1.1
- U Values by Component - R402.1.2
- R Value and R Value Computation R402.1.3 & R402.1.4
- R value Table R402.1.3
- Total UA Alternative & Calculations R402.1.5 – 402.1.6

R402.2 Specific Insulation Requirements

- Ceilings and Attics R402.1 – R 402.2.4.1
- Mass Walls R402.2.5
- Steel Framing R402.2.6
- Other Building Components R402.2.7 –R402.2.10

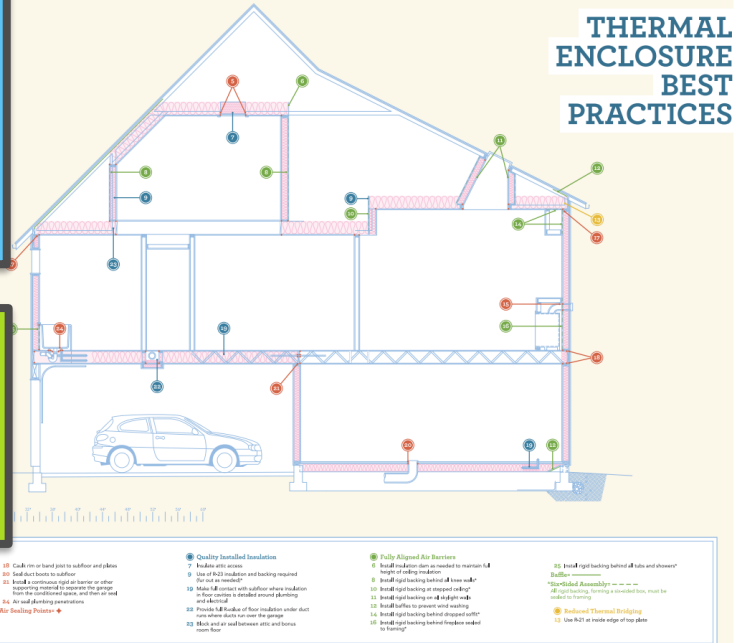
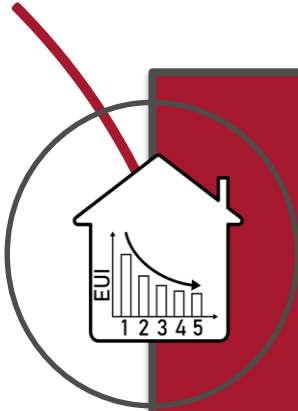


Photo courtesy of: Betterbuiltnw.org

Building Thermal Envelope:



R402.1.5 Total UA Alternative

- If the proposed building thermal envelope UA is less than or equal to the target UA, the building shall be considered in compliance with Table R402.1.2. The proposed UA shall be calculated in accordance with Equation 2. The target UA shall be calculated in accordance with Equation 1. U-factors shall be determined as specified in Section R402.1.6. In addition to UA compliance, the maximum fenestration U-factors of Section R402.5 shall be met.



R402.1.6 U-Factor Reference and Calculations

- The U-factors for typical construction assemblies are included in Appendix A in chapter 51-11C WAC. These values shall be used for all calculations.
- Where proposed construction assemblies are not represented in Appendix A, values shall be calculated in accordance with the ASHRAE Handbook of Fundamentals using the framing factors listed in Appendix A where applicable and shall include the thermal bridging effects of framing materials. The SHGC requirements shall be met in addition to UA compliance.

Building Thermal Envelope:

402.3 Fenestrations

- Vapor Retarders - R402.1.1
- U Values by Component - R402.1.2
- R Value and R Value Computation R402.1.3 & R402.1.4
- R Value Table R402.1.3
- Total UA Alternative & Calculations R402.1.5 – 402.1.6



WEST VIRGINIA STATE ENERGY CODE COMMERCIAL PROVISIONS APPENDIX A

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Roof	AE-17		

Photo courtesy of:

[WSEC-R Appendix A](#) table of contents

Building Thermal Envelope:

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

- a. R-values are minimums. U-factors and SHGC are maximums. When insulation is installed in a cavity which is less than the label or design thickness of the insulation, the compressed R-value of the insulation from Appendix Table A101.4 shall not be less than the R-value specified in the table.
- b. The fenestration U-factor column excludes skylights.
- c. "10/15/21 +5TB" means R-10 continuous insulation on the exterior of the wall, or R-15 continuous insulation on the interior of the wall, or R-21 cavity insulation plus a thermal break between the slab and the basement wall at the interior of the basement wall. "10/15/21 +5TB" shall be permitted to be met with R-13 cavity insulation on the interior of the basement wall plus R-5 continuous insulation on the interior or exterior of the wall. "5TB" means R-5 thermal break between floor slab and basement wall.
- d. R-10 continuous insulation is required under heated slab on grade floors. See Section R402.2.9.1.
- 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.
- f. R-7.5 continuous insulation installed over an existing slab is deemed to be equivalent to the required perimeter slab insulation when applied to existing slabs complying with Section R503.1.1. If foam plastic is used, it shall meet the requirements for thermal barriers protecting foam plastics.
- g. For log structures developed in compliance with Standard ICC 400, log walls shall meet the requirements for climate zone 5 of ICC 400.
- h. Int. (intermediate framing) denotes framing and insulation as described in Section A103.2.2 including standard framing 16 inches on center, 78 percent of the wall cavity insulated and headers insulated with a minimum of R-10 insulation.
- i. The first value is cavity insulation, the second value is continuous insulation. Therefore, as an example, "R13+10" means R-13 cavity insulation plus R-10 continuous insulation.
- j. A maximum U-factor of 0.32 shall apply to vertical fenestration products installed in buildings located above 4000 feet in elevation above sea level, or in windborne debris regions where protection of openings is required under Section R301.2.1.2 of the International Residential Code.

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

- a. U-factors or F-factors shall be obtained from measurement, calculation, or an approved source or as specified in Section R402.1.5.
- b. A maximum U-factor of 0.32 shall apply to vertical fenestration products installed in buildings located above 4000 feet in elevation above sea level, or in windborne debris regions where protection of openings is required under Section R301.2.1.2 of the International Residential Code.

Building Thermal Envelope:



WASHINGTON STATE UNIVERSITY
Energy Program

Insulation Certificate for Residential New Construction

Permit #:	
House address or lot number:	
Walls	Blown or Sprayed Fiberglass or Cellulose - Walls
Type of insulation:	R-value per inch:
Manufacturer:	Coverage area:
FG Density: 1.8Lbs./Ft ³ Cellulose: 3.5-4.3Lbs./Ft ³	Installed Density Per Ft. ³
R-value:	Bag count:
Floor	Blown or Sprayed Fiberglass or Cellulose - Ceiling
Type of insulation:	Settled R-value per inch:
Manufacturer:	Coverage area:
R-value:	Bag count:
Flat Ceiling/Attic	Sprayed Polyurethane Foam (SPF)
Type of insulation:	Density: <input type="checkbox"/> 0.5Lbs./Ft ³ <input type="checkbox"/> 2.0Lbs./Ft ³
Manufacturer:	Installed thickness:
R-value:	R-value of installed thickness:
Single Rafter Joist Vaulted Ceiling	Building component installed: (circle one) walls floor ceiling
Type of insulation:	
Manufacturer:	
R-value:	
Insulation Installer	
Company name:	
Installer name: (Print)	
Installer signature:	
Date:	
Phone number:	
Email:	

Washington State Energy Code Reference

See attached page for specifications

2021 WSEC Residential Energy Compliance Certificate (Effective November 1, 2024)	Property address: _____		
	Builder/registered design professional name: _____		
	Builder/reg. design pro. signature: _____		
	Conditioned floor area: _____ ft ² (per building permit)		
	R-Values (R303.1.1)		
	Ceiling/ Attic:	Vaulted R-_____ Attic R-_____	Floors: Over unconditioned space R-_____ Slab-on-grade floor R-_____
	Walls:	Above grade R-_____ Below, int. R-_____ Below, ext. R-_____	Fully insulated slab? Y/N (Circle one) Doors: R-_____, R-_____, R-_____
	U-Value of Windows, Skylights and Doors (R303.1.1.3)		
	Average area weighted U-value from Glazing Worksheet		Average U- _____
	Energy Equalization Credits (Tables R406.2) and Energy Credits (Table R406.3)		
	System Type Number (1 to 5) _____ (Select one)		
	Energy Credits selected (1 to 7) _____		
	Energy Equalization Credit _____ + Total Energy Credits _____ = Total Credits _____		
	Heating, Cooling and Domestic Hot Water		
	System	Type (Manufacturer and Model Number)	Efficiency
Heating			
Cooling			
DHW			
Drain water heat recovery			
Onsite Renewable Energy Electric Power System			
System type _____		System design capacity _____ kW	
Rated annual generation _____ kWh/yr.			
Appliances		Energy Star?	
Manufacturer and Model		(Circle one)	
Dish washer		Y or N	
Refrigerator		Y or N	
Washer		Y or N	
Dryer		Y or N	
Vented or unvented? _____		If vented, CEF rating _____	
Gas fireplace / heating stove (Section R402.4.2)		Fireplace efficiency (FE) _____	
Heating or Decorative? (Circle one)			

Building Thermal Envelope:

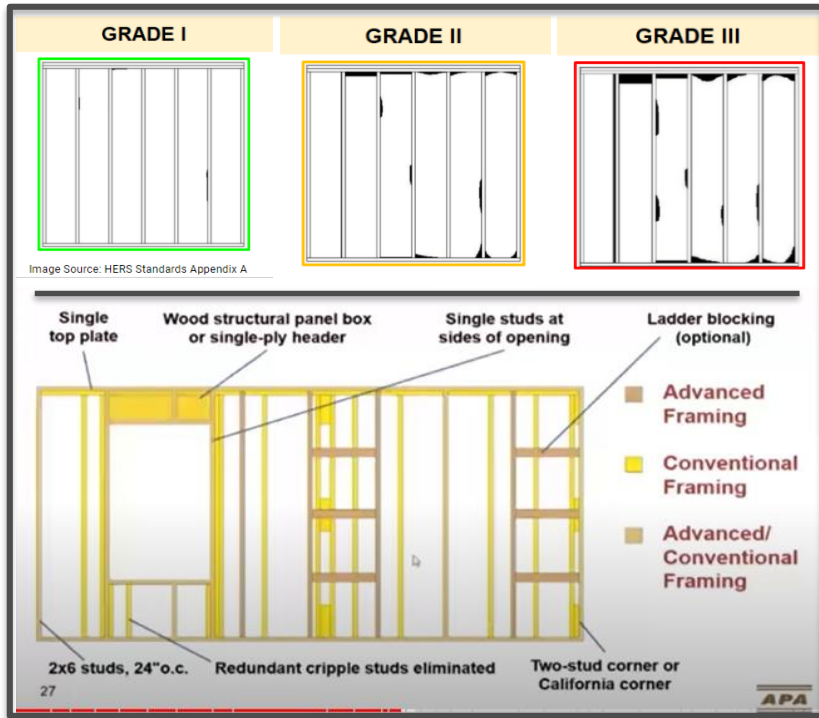
R402.3.6 Fireplaces.

- New wood-burning fireplaces shall have tight-fitting flue dampers or doors, and outdoor combustion air. When using tight-fitting doors on factory-built fireplaces listed and labeled in accordance with UL 127, the doors shall be tested and listed for the fireplace. Where using tight-fitting doors on masonry fireplaces, the doors shall be listed and labeled in accordance with UL 907. Gas fire places shall comply with the efficiency requirements in Section R403.7.2.



Photo taken of [NAHB IBS Booth](#)

Building Thermal Envelope:



ADVANCED FRAMED WALLS

Definitions R202

Studs framed on 24-inch centers with double top plate and single bottom plate. Corners use two studs or other means of fully insulating corners, and one stud is used to support each header. Headers consist of double 2x material with R-10 insulation between the header and exterior sheathing. Interior partition wall/ exterior wall intersections are fully insulated in the exterior wall. (See Standard Framing and Appendix A of this code.)

Photo Courtesy of [APA](https://www.apawood.org/):

<https://www.apawood.org/construction-drawings>


<https://www.apawood.org/advanced-framing>

Building Thermal Envelope:



Photo Courtesy of: [Rockwool.com](https://www.rockwool.com)

6300 Enterprise Lane
Madison, Wisconsin 53719
608-310-6710



ANSI/ABTG FS200.1 – 2022

Standard for Use of Foam Plastic Insulating Sheathing (FPIS) in Building Envelopes: Above-grade Walls




Photo Courtesy of: Foam [Plastic Applications for better buildings](https://www.fplastic.com)

Building Thermal Envelope:



R-60 Attics

Rafter framing and Raised Heel Trusses

[3] Gaining more height requires more engineering but can be done by adding a taller vertical web between the top and bottom chords over the exterior walls.

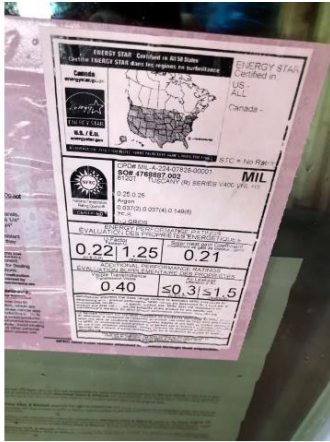
[2] Raised-heel trusses improve on standard truss designs by raising the top chord. The simplest solutions insert a 2x6 block or a short vertical web between the top and bottom chords.

Building Thermal Envelope:

New window type?

Thin Triple Pane window systems.

NEEA High-Performance Window offering



- 0.22 U-value or better (5% of market) (0.20 is 2-3%)
- Same dimension as a double pane window
- Mostly Hybrid Triples are used in NEEA's HPW
- Available from most window manufacturers

Thin Triples?

This slide was gleaned from a BetterBuiltNW training. In a follow up conversation we discussed that the thickness dimension of the window also matched double pane thickness. Making it retrofitting friendly for existing 2x4 construction.

Building Thermal Envelope:

New window type?

High Efficiency Storm Window Systems

QUANTAPANEL® 704-DH IGS Storm Windows

Manufacturer: QUANTA Technologies, Inc.
Product Line: QUANTAPANEL® 704-DH IGS
AERC Number: WP-L-BSBQY
Position (Interior/Exterior): Exterior
Model #: QP 704-DH IGS
Date Certified: 2020-12-30

Product Description: Ultra low-profile, exterior 2-track system with a removable upper sash and removable screen in the outer track; and an inner sash that opens vertically to adjust glass.

Cool Climate Rating
0 75 110
Storm Windows
Cool Climate Max: 110

Warm Climate Rating
0 19 110
Storm Windows

Manufacturer Website: <https://www.quantapanel.com>

More Information:
Double Pane, Clear Glass, Non-Metal Frame

U-FACTOR	SHGC	VT	AL
0.26	0.45	0.49	1.15

Show less

U-Factor: 0.26

Solar Heat Gain Coefficient: 0.45

Visual Transmittance: 0.49

Air Leakage: 1.15

QUANTAPANEL IGS Storm Windows

Storm Windows are our passion at QUANTA Technologies, Inc. and we manufacture more than just plain old storm windows. In fact we like to refer to our product as an Insulating Glass System (IGS). Our IGS Low-E storm windows have been developed to be efficient, architectural, and much more affordable than replacement windows. Let us show you how our products will improve the building envelope of your residential or commercial structure while maintaining its historical accuracy.



No video, image of site



Available in 213 Colors

Storm Windows

Not the same old storm windows of the past. High performance and aesthetically pleasing, garage conversion perhaps?

Building Thermal Envelope:



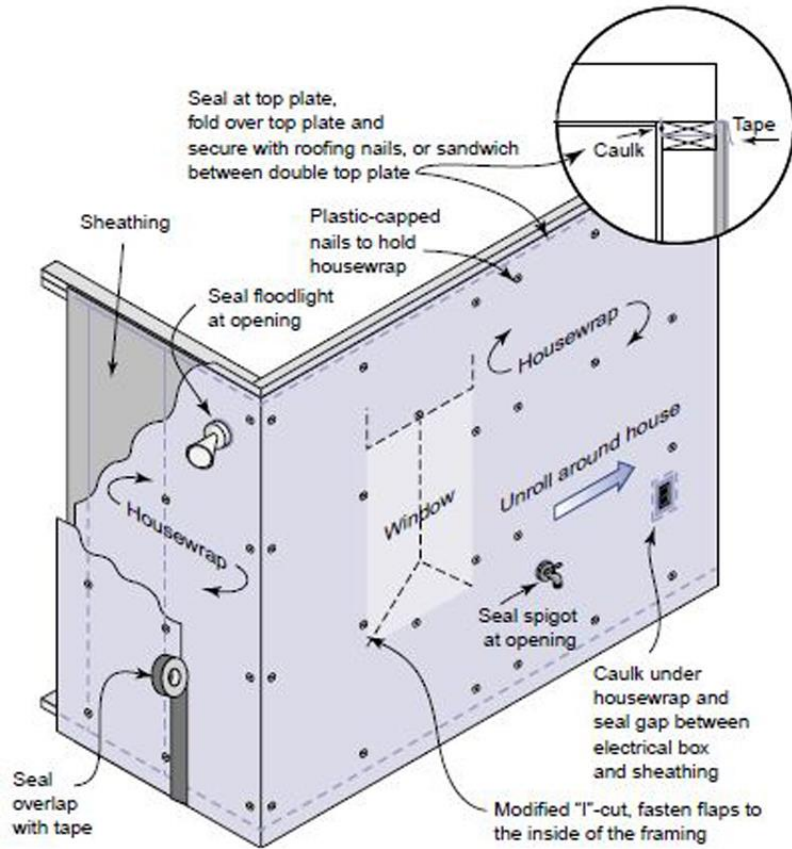
R402.4 Air Leakage

- Building Thermal Envelope Air Leakage
- Installation of the Building Thermal Envelope
- Testing
- Air Barrier, Air Sealing, & Insulation Chart R402.4.1.1
- Leakage Rate & Dwelling Leakage Rates R402.4.1.3 – R402.4.2
- Fenestration Leakage Rate R402.1.3.2

Testing of single-family dwellings and townhouses shall be conducted in accordance with RESNET/ICC 380. Test pressure and leakage rate shall comply with Section R402.1.3.1.

For Group R-2 occupancies, testing shall be conducted in accordance with ASTM E779, ASTM E1827, or ASTM E3158. Test pressure and leakage rate shall comply with Section R402.1.3.2. **The individual performing the air leakage test shall be trained and certified by a certification body that is, at the time of permit application, and ISO 17024 accredited certification body including, but not limited to, the Air Barrier Association of America.**

Building Thermal Envelope:



Air Barriers & Air Sealing

Air Barrier: One or more materials joined together in a continuous manner to restrict or prevent the passage of air through the building thermal envelope and its assemblies.

- R402.4.1 Building Thermal Envelope The building thermal envelope shall comply with Sections R402.4.1.1 and R402.4.1.2.
- The sealing methods between dissimilar materials shall allow for differential expansion and contraction.



Building Thermal Envelope:

R402.4.1.1 Air Barrier and Insulation installation

WAC 51-11R-40241 Table R402.4.1.1—Air barrier and insulation installation.

TABLE R402.4.1.1
AIR BARRIER, AIR SEALING AND INSULATION INSTALLATION*

COMPONENT	AIR BARRIER CRITERIA(†)	INSULATION CRITERIA(†)
General requirements	A continuous air barrier shall be installed in the building envelope. ((Exterior thermal envelope contains a continuous air barrier.)) Breaks or joints in the air barrier shall be sealed.	Air-permeable insulation shall not be used as a sealing material.
Cavity insulation installation		All cavity insulation shall be installed in accordance with Section R402.4.1.1. Insulation shall be installed in accordance with Section R402.4.1.1. Insulation shall be installed in accordance with Section R402.4.1.1.

COMPONENT	AIR BARRIER CRITERIA(†)	INSULATION CRITERIA(†)
Garage separation	Air sealing shall be provided between the garage and conditioned spaces.	Insulated portions of the garage separation assembly shall be installed in accordance with Sections R303 and R402.2.8.
Recessed lighting	Recessed light fixtures installed in the building thermal envelope shall be air sealed ((to the finished surface)) in accordance with Section R402.4.5.	Recessed light fixtures installed in the building thermal envelope shall be air tight and IC rated and shall be buried or surrounded with insulation.
Plumbing (and) wiring, or other obstructions	All holes created by wiring, plumbing, or other obstructions in the air barrier assembly shall be air sealed.	Batt insulation shall be cut neatly to fit around wiring and plumbing in exterior walls. There shall be no voids or gaps or compression where cut to fit. Insulation that on installation readily conforms to available space shall extend behind piping and wiring. Insulation shall be installed to fill the available space and surround wiring, plumbing, or other obstructions, unless the required R-value can be met by installing insulation and air barrier systems completely to the exterior side of the obstructions.
Shower/tub on exterior wall	The air barrier installed at exterior walls adjacent to showers and tubs shall separate the wall from the showers and tubs.	Exterior walls adjacent to showers and tubs shall be insulated.
Electrical/phone box on exterior wall	The air barrier shall be installed behind electrical or communication boxes or air sealed boxes shall be installed.	
HVAC register boots	HVAC supply and return register boots shall be sealed to the subfloor, wall covering or ceiling penetrated by the boot.	
Concealed sprinklers	When required to be sealed, concealed fire sprinklers shall only be sealed in a manner that is recommended by the manufacturer. Caulking or other adhesive sealants shall not be used to fill voids between fire sprinkler cover plates and walls or ceilings.	

COMPONENT	AIR BARRIER CRITERIA(†)	INSULATION CRITERIA(†)
Ceiling/attic	The air barrier in any dropped ceiling/soffit shall be aligned with the insulation and any gaps in the air barrier sealed. Access openings, drop down stair or knee wall doors to unconditioned attic spaces shall be sealed.	The insulation in any dropped ceiling/soffit shall be aligned with the air barrier. Batt insulation installed in attic roof assemblies may be compressed at exterior wall lines to allow for required attic ventilation.
Walls	The junction of the foundation and sill plate shall be sealed. The junction of the top plate and top of exterior walls shall be sealed. Knee walls shall be sealed.	Cavities within corners and headers of frame walls shall be insulated by completely filling the cavity with a material having a thermal resistance of R-3 per inch minimum. Exterior thermal envelope insulation for framed walls shall be installed in substantial contact and continuous alignment with the air barrier.
Windows, skylights and doors	The space between window/door jambs and framing and skylights and framing shall be sealed.	
Rim joists	Rim joists shall include ((the)) an exterior air barrier. The junctions of the rim board to the sill plate and the rim board and the subfloor shall be air sealed.	Rim joists shall be insulated so that the insulation maintains permanent contact with the exterior rim board.
Floors (including above garage and cantilevered floors)	The air barrier shall be installed at any exposed edge of insulation.	Floor framing cavity insulation shall be installed to maintain permanent contact with the underside of subfloor decking or floor framing cavity insulation shall be permitted to be in contact with the topside of sheathing or continuous insulation installed on the underside of the framing and extend from the bottom to the top of all perimeter floor framing members.

Unvented crawl spaces shall be sealed with a Class I, black vapor retarder using joint tapes.	((Where provided instead of floor insulation, insulation shall be permanently attached to the crew-space ceiling.)) Crawl space insulation, where provided instead of floor insulation, shall be installed in accordance with Section R402.2.10.
through concrete foundation shall be air sealed.	Conditioned basement foundation wall insulation shall be installed in accordance with Section R402.2.8.1.
retarders shall not be used as an below-grade walls and shall be installed in accordance with Section R402.7 of the International Residential Code.	Slab on grade floor insulation shall be installed in accordance with Section R402.2.10.
utility penetrations) and flue pipes) to exterior or unconditioned spaces shall be air sealed.	Insulation shall be fitted tightly around utilities passing through shafts and penetrations in the building thermal envelope to maintain required R-value.
ations of the air barrier shall be sealed, or otherwise sealed and expansion and contraction of mechanical vibration.	Batts in narrow cavities shall be cut to fit and installed to the correct density without any voids or gaps or compression, or narrow cavities shall be filled by insulation that on installation readily conforms to the available cavity space.

IC = insulation contact.
 † In addition, inspection of log walls shall be in accordance with the provisions of ICC-400.
 ‡ Insulation installed in unconditioned/ventilated attic spaces is not required to be enclosed within an air barrier assembly.



Building Thermal Envelope:

The interior air barrier here is needed if they are trading off exterior insulation!

**TABLE R402.4.1.1 (continued)
AIR BARRIER, AIR SEALING AND INSULATION INSTALLATION^a**

COMPONENT	AIR BARRIER CRITERIA	INSULATION CRITERIA
Windows, skylights and doors	The space between window/door jambs and framing and skylights and framing shall be sealed.	
Rim joists	Rim joists shall include an exterior air barrier ^b . The junctions of the rim board to the sill plate and the rimboard and the subfloor shall be air sealed.	Rim joists shall be insulated so that the insulation maintains permanent contact with the exterior rim board ^b .
Floors (including above garage and cantilevered floors)	The air barrier shall be installed at any exposed edge of insulation.	Floor framing cavity insulation shall be installed to maintain permanent contact with the underside of subfloor decking or floor framing cavity insulation shall be permitted to be in contact with the topside of sheathing.



Building Thermal Envelope:



Building Thermal Envelope:

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).

Exception: Additions tested with the existing home having a combined maximum air leakage rate of 7 air changes per hour. To qualify for this exception, the date of construction of the existing dwelling must be prior to the 2009 Washington State Energy Code.



Building Thermal Envelope:

R402.4.1.2 Testing

The building or dwelling unit shall be tested for air leakage. Testing shall be conducted in accordance with RESNET/ICC 380, ASTM E779 or ASTM E1827. Test pressure and leakage rate shall comply with Section R402.1.3. A written report of the test results, including verified location and time stamp of the date of the test, shall be signed by the testing agency and provided to the building owner and code official. Testing shall be performed at any time after creation of all penetrations of the building thermal envelope. Once visual inspection has confirmed air sealing (has been conducted in accordance with Table R402.4.1.1), operable windows and doors manufactured by small business are *permitted to be sealed off at the frame prior to the test.*

Exterior windows and doors, fireplace and stove doors shall be closed, but not sealed, beyond the intended weather-stripping or other infiltration control measures;

Dampers including exhaust, intake, makeup air, backdraft and flue dampers shall be closed, but not sealed beyond intended infiltration control measures;

Interior doors, if installed at the time of the test, shall be open, access hatches to conditioned crawl spaces and conditioned attics shall be open;

Exterior or interior terminations for continuous ventilation systems and heat recovery ventilators shall be sealed;

Heating and cooling systems, if installed at the time of the test, shall be turned off; and

Supply and return registers, if installed at the time of the test, shall be fully open.

Exception: Additions less than 500 square feet of conditioned floor area.



Building Thermal Envelope:

ABAA's current offering

Program Description

Overview

An interactive, 40-hour, 5-day, in-person training program, centered on commercial blower door testing, featuring conceptual learning and practical hands-on instruction from industry experts and representatives from both blower door manufacturers.

Course Description

The purpose is to educate both entry-level and experienced blower door technicians in the planning, preparation, and execution of a blower door airtightness test on commercial and large buildings in conformance with industry standard test methods.

Currently it is the MOST comprehensive blower door testing training program available covering ASTM E3158, E779, E1827, CGSB 149.10, ISO 9972, and USACE (2012) test methods.

The training aims to equip blower door technicians with the knowledge, skills, and abilities necessary to appropriately evaluate, prepare, test, analyze, and report on a building's airtightness performance.

For the purposes of demonstrations, activities, and simulations, this training program uses equipment from two widely used blower door fan manufacturing companies.

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.



[Whole Building Airtightness Program](#)
[- Air Barrier Association of America](#)

Building Thermal Envelope:



R402.4.3 Recessed lighting

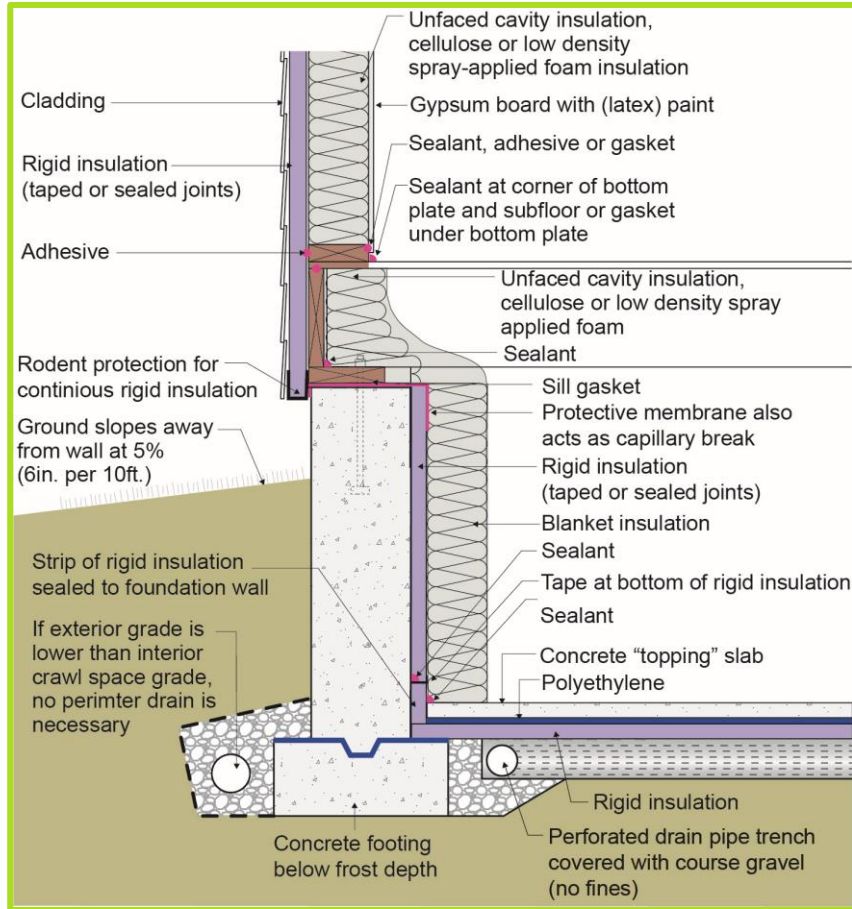
Recessed luminaires installed in the building thermal envelope shall be Type IC-rated and certified under ASTM E283 as having an air leakage rate not more than 2.0 cfm (0.944 L/s) when tested at a 1.57 psf (75 Pa) pressure differential and shall have a label attached showing compliance with this test method. All recessed luminaires shall be sealed with a gasket or caulk between the housing and the interior wall or ceiling covering.



R402.4.4 Electrical and communication outlet boxes (air-sealed boxes)

Electrical and communication outlet boxes installed in the building thermal envelope shall be sealed to limit air leakage between conditioned and unconditioned spaces. Electrical and communication outlet boxes shall be tested in accordance with NEMA OS 4, Requirements for Air-Sealed Boxes for Electrical and Communication Applications, and shall have an air leakage rate of not greater than 2.0 cubic feet per minute (0.944 L/s) at a pressure differential of 1.57 psf (75 Pa). Electrical and communication outlet boxes shall be marked [11] OTS-5010.1 "NEMA OS 4" or "OS 4" in accordance with NEMA OS 4. Electrical and communication outlet boxes shall be installed per the manufacturer's instructions and with any supplied components required to achieve compliance with NEMA OS 4.

Building Thermal Envelope:



Images courtesy of BSC, website provided

Events

Classes and seminars,
in-person and online



Publications

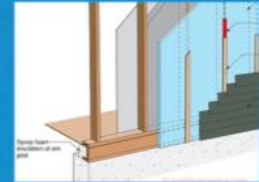
Classic and current
books and guides

Builder's Guide
to
**Cold
Climates**

*A systems approach to designing and
building homes that are safe, healthy*

Details

Technical guidance for
all climate zones



<https://buildingscience.com/>

Summary of Chapter R402
WSEC - Residential 2021
EPCA Edition:



- ✓ The Ceiling U-value has decreased to 0.024
- ✓ The Ceiling R-Value has increased to R-60
- ✓ The wall cavity R-Value has increased to R20+5. This modification means that wall assemblies require Continuous Insulation
- ✓ The wall U-Value for UA is 0.056.
- ✓ Air Leakage requirements are more stringent
 - 4 ACH@50Pa
 - 0.25 cfm per square foot of dwelling unit area maximum.
- ✓ New electrical outlet specifications on air tightness.
- ✓ New air barrier specification

Systems

Chapter 4 section R403 covers key points in Systems. This is the largest of the sections in Chapter 4. It generally covers anything that; heats, cools, or ventilates, and their distribution.



R 403.1 Controls

- Programmable & Connected Thermostat
- Heat Pump Supplementary Heat
- Continuous Burning Pilot Light.



R 403.2 H2O Boiler Temp Reset

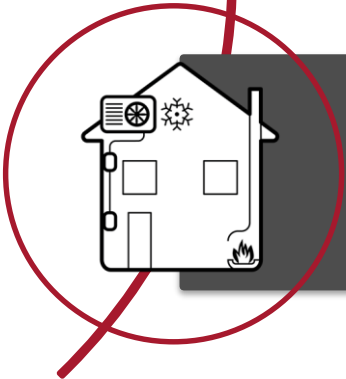
- The manufacturer shall configure each gas, oil and electric boiler (other than a boiler equipped with a tankless domestic water heating coil) with an automatic means of adjusting the water temperature supplied by the boiler ...

Systems



R403.3 Ducts

- Ductwork & their location
- Ductwork & their insulation
- Duct work & their leakage/sealing/testing
- No building cavities as plenums



R403.4 Mechanical System Pipe Insulation

- Mech. system piping capable of carrying fluids above 105 degrees or below 55 degrees shall be insulated to a min. of R-6
- Protection of piping insulation (removable)

Systems

Common Code support request topic R-403.3.2, ducts located in...

R403.3.2.4 Ductwork in floor cavities located over unconditioned space shall comply with all of the following:

- 4.1. A continuous air barrier installed between unconditioned space and the duct.
- 4.2. Insulation installed in accordance with Section R402.2.7.
- 4.3. A minimum R-19 insulation installed in the cavity width separating the duct from unconditioned space.

R403.3.2.5 Ductwork located within exterior walls of the building thermal envelope shall comply with the following:

- 5.1. A continuous air barrier installed between unconditioned space and the duct.
- 5.2. A minimum R-10 insulation installed in the cavity width separating the duct from unconditioned space.
- 5.3. The remainder of the cavity insulation shall be fully insulated to the drywall side.

R403.3.7 Building cavities. Building framing cavities shall not be used as ducts or plenums. Installation of ducts in exterior walls, floors or ceilings shall not displace required envelope insulation.

Systems

R403.3.5 Duct Testing

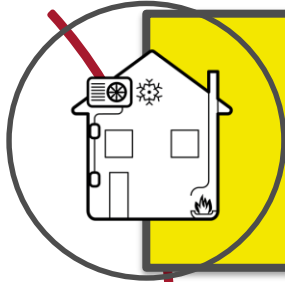
- Ducts shall be leak tested in accordance with WSU RS-33, using the maximum duct leakage rates specified.
- EXCEPTION: A duct air leakage test shall not be required for ducts serving ventilation systems that are not integrated with the ducts serving heating or cooling systems.
- A written report of 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:

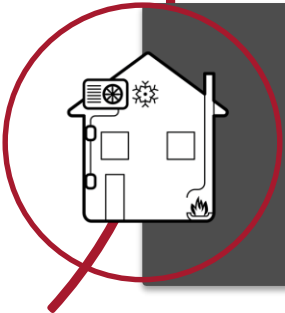
- Test for ducts within thermal envelope: Where all ducts and air handlers are located entirely within the building thermal envelope, total leakage shall be less than or equal to 8.0 cubic feet per minute (226.6 L/min) per 100 square feet (9.29 m²) of conditioned floor area. For forced air ducts, a maximum 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.

Systems



R403.5 Service Hot Water Systems

- Circulation Pump, Demand Circ. Pumps &, Heat Trace Requirements
- Water distribution, distribution efficiencies & installation Location.
(note, this is where the electric water tank must be in conditioned space is located)



R403.6 Mechanical Ventilation

- This section defines the ventilation requirements for the different dwelling types.
- It covers sound, distribution efficiencies, & unit energy use per cfm.
- Establishes Testing/commissioning requirements



How long should you wait for hot water?

Volume in the Pipe (ounces)	<u>Minimum</u> Time-to-Tap (seconds) at Selected Flow Rates					
	0.25 gpm	0.5 gpm	1 gpm	1.5 gpm	2 gpm	2.5 gpm
2	4	1.9	0.9	0.6	0.5	0.4
4	8	4	1.9	1.3	0.9	0.8
8	15	8	4	2.5	1.9	1.5
16	30	15	8	5	4	3
24	45	23	11	8	6	5
32	60	30	15	10	8	6
64	120	60	30	20	15	12
128	240	120	60	40	30	24

Compact water design

ASPE Time-to-Tap Performance Criteria

Light Green	Acceptable Performance	1 – 10 seconds
Orange	Marginal Performance	11 – 30 seconds
Pink	Unacceptable Performance	31+ seconds

Source: Domestic Water Heating Design Manual – 2nd Edition, ASPE, 2003, page 234

Systems

R403.5.2 Water volume determination.

The volume shall be the sum of the internal volumes of pipe, fittings, valves, meters, and manifolds between the nearest source of heated water and the termination of the fixture supply pipe. Water heaters, circulating water systems, and heat trace temperature maintenance systems shall be considered to be sources of heated water.

The volume in the piping shall be determined from Table C404.3.1 in the Washington State Energy Code, Commercial Provisions or Table L502.7 of the Uniform Plumbing Code. The volume contained within fixture shutoff valves, within flexible water supply connectors to a fixture fitting and within a fixture fitting shall not be included in the water volume determination.

Where heated water is supplied by a recirculating system or heat-traced piping, the volume shall include the portion of the fitting on the branch pipe that supplies water to the fixture.



Systems

How to Find the Volume of a Pipe

The volume of fluid in a pipe can be found given the inner diameter of the pipe and the length. To estimate pipe volume, use the following formula:

$$\text{volume} = \pi \times \frac{d^2}{4} \times h$$

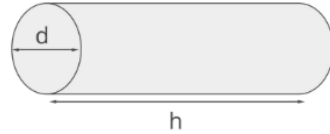
Thus, the volume of a pipe is equal to pi times the pipe diameter d squared over 4, times the length of the pipe h .

This formula is derived from the [cylinder volume formula](#), which can also be used if you know the radius of the pipe.

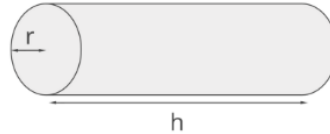
$$\text{volume} = \pi \times r^2 \times h$$

Find the diameter and length of the pipe in inches or millimeters. Use our [feet and inches calculator](#) to calculate a length in inches or millimeters.

Formula to Calculate Pipe Volume



$$v = \pi \times \frac{d^2}{4} \times h$$



$$v = \pi \times r^2 \times h$$

Pipe Volume Calculator

Calculate the volume of a pipe given its inner diameter and length. The calculator will also find how much that volume of water weighs.

Diameter: in

Length: ft

CALCULATE

Results:

Volume

cu in

gallons

Weight

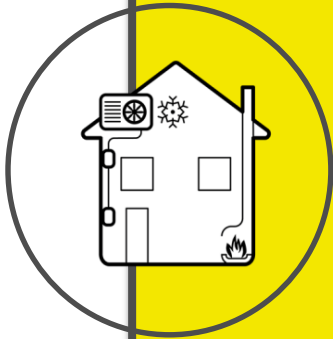
lbs

<https://www.inchcalculator.com/pipe-volume-calculator/>

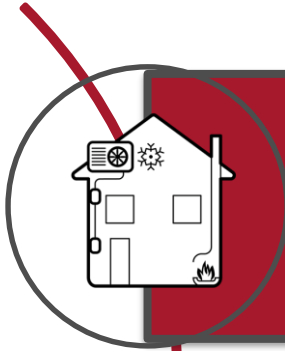
Systems

R403.5.7.1 Supplementary Heat for HP H2O Heating

- Supplementary heat for heat pump water heating systems. Heat pumps used for water heating and having supplementary water heating equipment shall have controls that limit supplementary water heating equipment operation to only those times when one of the following applies:
 - 1. The heat pump water heater cannot meet hot water demand.
 - 2. For heat pumps located in unconditioned space, the outside air temperature is below 40°F (4°C).
 - 3. The heat pump is operating in defrost mode.
 - 4. The vapor compression cycle malfunctions or loses power.
- **Exception:** Heat trace temperature maintenance systems, provided the system capacity does not exceed the capacity of the heat pump water heating system.

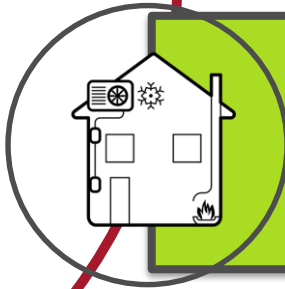


Systems



R 403.7 Equipment Sizing

- Requires Manual J & S or other approved calc.
- Cooling shall not exceed the smallest available equipment size that meets the load calcs.
- Gas Fire Place Efficiencies



R 403.8 Systems Servicing Multiple Dwelling Units

- Systems serving multiple dwelling units shall comply with Sections C403 and C404 of the WSEC--Commercial Provisions in lieu of Section R403.

Systems

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.

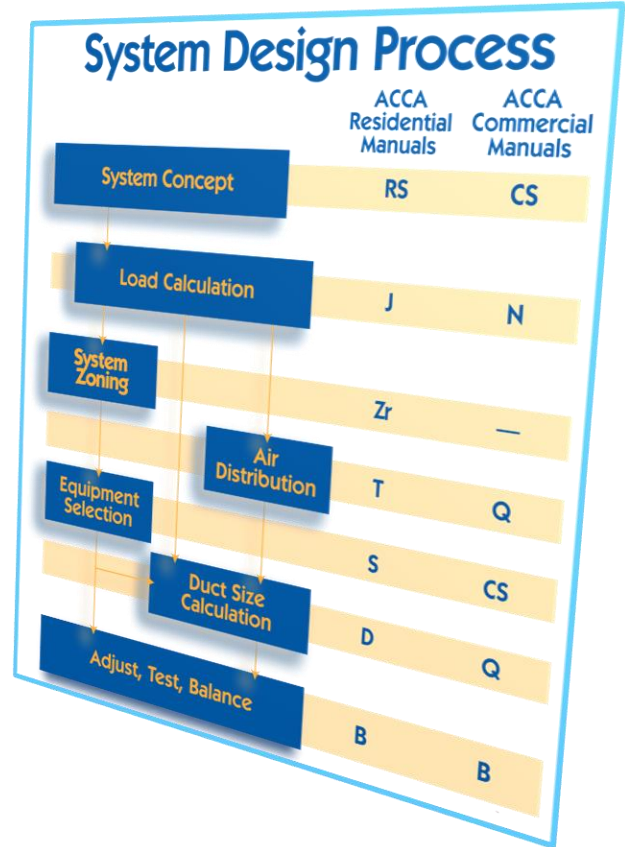


Image courtesy of ACCA

ACCA Manual and Sizing Capable Software



BetterBuilt^{NW}

HVAC SIZING TOOL

A Free Software for HVAC Professionals

In as little as 15 minutes, contractors can calculate heating and cooling requirements and identify ways to improve the energy efficiency of their projects. HVAC Sizing Tool was created by electric and gas utility programs to help contractors right-size HVAC equipment. To start using it today, go to: <https://www.hvac sizingtool.com>

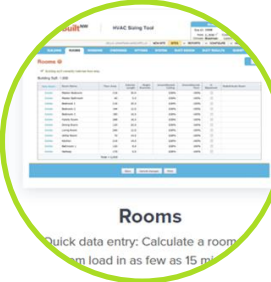
The WSU-EP Simple heat calculator does not performing cooling calculations for AC's or heat pump units! R403.3 requires the use of proper ACCA Manuals or approved alternative calculation. If software is needed, **BetterBuiltNW.com** offers HVAC ST.

Heating, Ventilation, & Air-Conditioning Sizing Tool




Sites

Thousands of weather locations to choose from, including USA and international.




Rooms

Quick data entry: Calculate a room's load in as few as 15 minutes.




Component Loads

Easily identify opportunities to improve the building envelope.



Results

Visualize system performance for multiple equipment selections.



System Selection

Compare hundreds of manufacturers to choose the best system, or create your own.





Washington State Building Code Council

Improving the built environment by promoting health, safety and welfare

1500 Jefferson Street SE • P.O. Box 41449 • Olympia, Washington 98504
(360) 407-9277 • e-mail sbcc@des.wa.gov • www.sbcc.wa.gov

STATE BUILDING CODE OPINION NO. 23-08

- CODE:** 2018/2021 Washington State Energy Code
- SECTION:** Primarily R405, R406, and C406, cited efficiency values
- QUESTION:** Our current residential and commercial energy codes specify certain equipment performance minimums in terms of their tested HSPF. Beginning next year, the HSPF is being replaced with HSPF2 to reflect a new testing method that better represents actual operating conditions. This creates a problem for determining compliance with the energy code since new equipment will only be listed with HSPF2, not an HSPF rating, that is currently in the 2018 code.
- Will the SBCC be providing a conversion chart to providing equivalence between HSPF and HSPF2 for the Commercial and Residential energy codes?
- ANSWER:** The attached table from AHRI and CEE may be used to convert SEER, EER and HSPF to the new DOE efficiency standards.

SUPERSEDES: 23-04, 22-02

REQUESTED BY: SBCC

How do I convert from Appendix M ratings to Appendix M1?

If looking to convert Appendix M ratings to new Appendix M1 ratings, AHRI recommends using the following crosswalk. To use, multiply the Appendix M rating (SEER, EER, HSPF) by the appropriate number of the corresponding Appendix M1 heading (SEER2, EER2, HSPF2) in the table below.

System Type	SEER2	EER2	HSPF2
Ducted	0.95	0.95	0.85
Ductless	1.00	1.00	0.90
Packaged	0.95	0.95	0.84

How do I convert from Appendix M1 ratings to Appendix M?

If looking to convert new Appendix M1 ratings to Appendix M values, AHRI recommends using the following equations below.

System Type	Equation
Split System Air Conditioner and Heat Pump	SEER = SEER2 X 1.05
Split System Air Conditioner and Heat Pump	EER = EER2 X 1.04
Split System Heat Pump	HSPF = HSPF2 X 1.18
Packaged Air Conditioner and Heat Pump	SEER = SEER2 X 1.04
Packaged Air Conditioner and Heat Pump	EER = EER2 X 1.04
Packaged Heat Pump	HSPF = HSPF2 X 1.18
Ductless Heat Pump	HSPF = HSPF2 X 1.12
Space Constrained System	SEER = SEER2 X 1.01
Space Constrained System	HSPF = HSPF2 X 1.17
Small Duct High Velocity System	SEER = SEER2 X 1.00
Small Duct High Velocity System	HSPF = HSPF2 X 1.18

¹ US Department of Energy 10 CFR Part 430 Subpart B - Uniform Test Method for Measuring the Energy Consumption of Central Air Conditioners and Heat Pumps.



System Type	SEER2	EER2	HSPF2
Ducted	0.95	0.95	0.85
Ductless	1.00	1.00	0.90
Packaged	0.95	0.95	0.84

ENERGYGUIDE
Central Air Conditioner
Cooling Only
Split System
Efficiency Rating (SEER2)
14.3
Range of Similar Models
Notice: Federal law allows this unit to be installed only in: AK, AL, AR, CO, CT, DC, DE, FL, GA, HI, IL, IN, IA, KS, KY, LA, MA, ME, MD, MI, MN, MO, MS, MT, NC, ND, NE, NH, NJ, NY, OH, OK, OR, PA, RI, SC, SD, TN, TX, UT, VA, VT, WA, WI, WY, and U.S. territories.

ENERGYGUIDE
Central Air Conditioner
Cooling Only
Single Package
Efficiency Rating (SEER2)
14.0
Range of Similar Models
Notice: Federal law allows this unit to be installed only in: AK, AL, AR, CO, CT, DC, DE, FL, GA, HI, IL, IN, IA, KS, KY, LA, MA, ME, MD, MI, MN, MO, MS, MT, NC, ND, NE, NH, NJ, NY, OH, OK, OR, PA, RI, SC, SD, TN, TX, UT, VA, VT, WA, WI, WY, and U.S. territories.

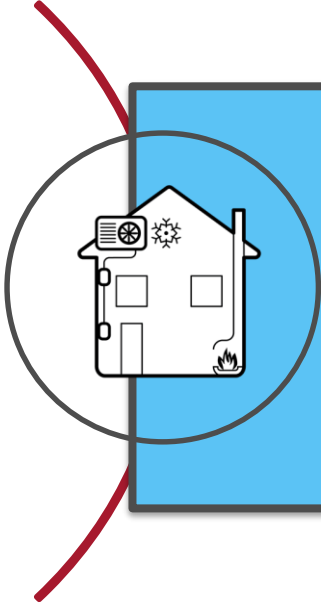
ENERGYGUIDE
Heating
Efficiency Rating (SEER2)
8.6-10.0
Range of Similar Models
Notice: Federal law allows this unit to be installed only in: AK, AL, AR, CO, CT, DC, DE, FL, GA, HI, IL, IN, IA, KS, KY, LA, MA, ME, MD, MI, MN, MO, MS, MT, NC, ND, NE, NH, NJ, NY, OH, OK, OR, PA, RI, SC, SD, TN, TX, UT, VA, VT, WA, WI, WY, and U.S. territories.

Sticker, Charts, & HSPF2

Use the crosswalk to select your equipment for the 406.3 charts

Make sure your sticker has the correct location selected on the map.

Systems



R403.6 Mechanical Ventilation.

- The buildings complying with Section R402.4.1 shall be provided with mechanical ventilation that meets the requirements of Section M1505 in the International Residential Code or Section 403 in the WA Mechanical Code, as applicable, or with other approved means of ventilation. Outdoor air intakes and exhausts shall have automatic or gravity dampers that close when the ventilation system is not operating.

Systems

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

- Mechanical ventilation system fans shall meet the efficacy requirements of Table R403.6.1 at one or more rating points. 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).



Systems

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.



Systems



Image and article: <https://reviewed.usatoday.com/home-outdoors/best-right-now/the-best-toilet-paper>

Systems

**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

TAB
WHOLE HOUSE MECHANICAL

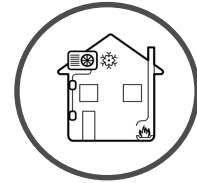
For SI: 1 cfm = 28.3 L/min.

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

((Fan Location	Air-Flow Rate Minimum (cfm)		
HRV or ERV	Any	1.2 cfm/watt	Any
Range hoods	Any	2.8	Any
In-line fan	Any	2.8	Any
Bathroom; utility-room	10	1.4	<90
Bathroom; utility-room	90	2.8	Any))



Air Barrier, HVAC Duct, & Ventilation Testing		Circle one
All ductwork and air handler in conditioned space? (See Option 4.2)		Y or N
All ductwork in unconditioned spaces tested at 4% total leakage.		Y or N
All ductwork in conditioned space tested at 8% total leakage.		Y or N
All ductwork & air handler outside conditioned space insulated to minimum R-8?		Y or N
Air handler present at duct leakage test? (Total leakage 4% if yes, 3% if no)		Y or N
Do HVAC duct leakage tests include GPS and time stamp verification?		Y or N
HVAC system leakage test calculated design target: _____	CFM @ 25 Pa	
HVAC system leakage test measured results: _____	CFM @ 25 Pa	
Building Leakage Testing (R402.4.1.2)		
Dwelling unit leakage test calculated design target: _____	ACH @ 50 Pa	
Dwelling unit leakage test, measured results: _____	ACH @ 50 Pa	
Whole Building Leakage test (R2 non-corridor only) design target: _____	CFM/sf @ 50 Pa	
Whole Building Leakage test (R2 non-corridor only) measured: _____	CFM/sf @ 50 Pa	
Do building leakage tests include GPS and time stamp verification?		Y or N
Whole House Ventilation System Measured Flow Rates (M1505.4 (R) (1) (A))		Circle one
Are the system controls correctly labeled?		Y or N
The Whole House Ventilation (WHV) system operation and maintenance (O&M) instructions were provided to the building owner?		Y or N
Provided to: _____ on _____ (date)		
Whole House Ventilation System Type: (Circle one)		
(1) Whole house exhaust fan, location _____		
(2) Balanced HRV/ ERV, location _____		
For R2 low-rise, serves more than one unit?		Y or N
(3) Supply or HRV WHV integral to the air handler. Describe system controls, sequence of operations or reference to design submittal: _____		
Specify run-time: _____ hours per day	_____ CFM	
WHV calculated design minimum flow rate per plan submittal:		
WHV measured min flow rate at commissioning: Exhaust _____ CFM, Supply _____ CFM		
Do WHV flow tests include GPS & time stamp verification?		Y or N
HRV/ERV sensible heat recovery efficiency: _____		
Commissioning Notes:		
All mandatory requirements of WSEC-R have been met?		Y or N



EPA & Radon Gas



**Do you know why it's important to
test your home for radon?**



**1 in 15 homes tests
high for radon levels**



**Radon is the 2nd
leading cause of lung
cancer, causing 21,000 lung
cancer deaths per year**



**Among non-smokers,
radon is the #1 cause
of lung cancer**

www.epa.gov/radon

EPA & Radon Gas

Share the Value of [Indoor airPLUS](#) Protection Against Radon

Let your clients know that many new Indoor airPLUS certified homes provide [radon-resistant construction](#), which includes:

- Gravel and plastic sheeting below slabs.
- Fully sealed and caulked foundation penetrations.
- Plastic vent pipe running from below slab through the roof.
- An attic receptacle to easily add an electric powered fan to the vent pipe if needed.

Radon-resistant construction is currently only required for homes built in zone 1 of the EPA's Map of Radon Zones. However, advisories in the specification remind builders that elevated levels of radon have been found in homes nationwide and recommend radon-resistant construction and testing in all Indoor airPLUS homes.

EPA & Radon Gas

More Information About Radon

- **Check out this guide** – [A Citizen's Guide to Radon](#) outlines important information on radon, useful for homebuilders and residents.
- **Learn about the lung cancer risks** – Read about the [risks associated with radon exposure](#) in homes to gain a better understanding of the importance of protecting homes.
- **Know radon hotlines and resources** – EPA provides [support hotlines](#) and connections to [training programs](#) for radon certifications.
- **Test your home** – EPA recommends that all homes in the U.S. be tested for radon. Testing is easy and inexpensive. [Radon test kits](#) can be obtained through the mail or at local hardware stores.
- **Build with radon-resistant features** – See [EPA guidance](#) for how to protect your homes from radon.
- **Learn about the [EPA Map of Radon Zones](#)**, and radon risks specific to your customers' EPA Regional Office, State, or Tribal program.

EPA & Radon Gas

WHAT TO LOOK FOR IN A RADON REDUCTION SYSTEM

In selecting a radon reduction method for your home, you and your contractor should consider several things, including: how high your initial radon level is, the costs of installation and system operation, your home size, and your foundation type.

Installation and Operating Costs

Most types of radon reduction systems cause some loss of heated or air conditioned air, which could increase your utility bills. How much your utility bills increase will depend on the climate you live in, what kind of reduction system you select, and how your home is built. Systems that use fans are more effective in reducing radon levels; however, they will slightly increase your electric bill.



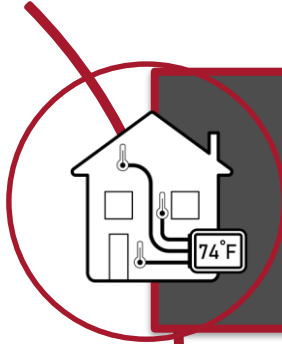
Radon!

Radon & Existing homes:

- [EPA's](#) guidance on radon & existing homes:
- 20 pages on existing homes
- Radon is still a silent killer!
- Working on additions or remodels and looking for guidance?

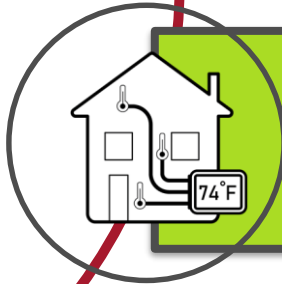
https://www.epa.gov/sites/default/files/2016-12/documents/2016_consumers_guide_to_radon_reduction.pdf

Systems



R 403.9 Snow melt system controls

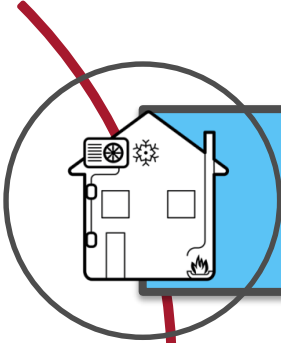
- Snow and ice-melting systems, supplied through energy service to the building, shall include automatic controls capable of shutting off the system when the pavement temperature is above 50°F, and no precipitation is falling



R 403.10 Energy Consumption; Pools & Spas

- This defines what heater, time switches, covers and pumps for pools and spas in WSEC-R

Systems



R403.11 Portable Spas

- The energy consumption of electric-powered portable spas shall be controlled by the requirements of APSP-14.



R403.12 Residential pools & permanent residential spas.

- The energy consumption of residential swimming pools and permanent residential spas shall be controlled in accordance with the requirements of APSP-15.

Summary of Chapter R403
WSEC - Residential
2021 EPCA Edition:



- ✓ Distribution location and efficiencies
 - ✓ Ducts inside now test @ 8% tested leakage rate
 - ✓ Piping and removable covers
- ✓ Dwelling Service H2O Systems, Distribution & Location of Equipment
 - ✓ Electric resistive tanks will be required to be installed inside.
- ✓ Mechanical Ventilation Systems
 - ✓ Energy, Sound and Distribution Efficiencies.
- ✓ Equipment Sizing and Selection Calculation Requirements
- ✓ Covers Pool and Spa's

Electric Power & Lighting Systems

Chapter 4, section R404 covers lighting efficiencies and control requirements.



R-404.1 Lighting Equipment

- R 404.1 Lighting Equipment
- All permanently installed lighting fixtures shall be a high efficiency source.
 - **Exception:** Kitchen Appliances.
- Exterior lighting will comply with C405.5
- Fuel Gas lighting requirements



R404.2 Interior Lighting Controls

- All permanently installed interior lighting fixtures shall be controlled by either a dimmer, an occupant sensor control or other control that is installed or built into the fixture.
- **Exception:** Bathrooms, hallways and safety/security areas.



R 404.3 Certification Exterior Lighting Controls

- Where the total permanently installed exterior lighting power is greater than 30 watts, the permanently installed exterior lighting shall comply with the following
- Lighting shall be controlled by a manual switch which provide automatic shut off.
- Daylight sensing
- **Exception/**requirements for override automatic system

Chapter 3

Summary of Section R404 WSEC - Residential 2021 EPCA Edition:



- ✓ All permanent fixture lighting must be high efficiency lighting.
- ✓ Interior lighting shall meet occupancy control requirements.
- ✓ Exterior Lighting automatic shut off during daylight hours for lighting over 30 watts.

Total Building Performance

Chapter 4, section R405 covers the total building performance pathway. This section of the chapter establishes the baseline home for the modeling procedure.



R 405.1 Scope

- This section establishes criteria for compliance using total building performance analysis. Such analysis shall include heating, cooling, mechanical ventilation and service water-heating energy only.



R 405.2 Performance based compliance

- Compliance based on total building performance requires that a proposed design meet all of the following:
- The requirements of the sections indicated within Table R405.2.
- For structures less than 1,500 square feet of conditioned floor area, the annual site energy consumption shall be less than or equal to 64 percent of the annual site energy consumption of the standard reference design.
- For structures 1,500 to 5,000 square feet of conditioned floor area, the annual site energy consumption shall be no more than 47 percent of the standard reference design.
- For structures over 5,000 square feet of conditioned floor area, the annual site energy consumption shall be no more than 41 percent of the standard reference design.
- For structures serving Group R-2 occupancies, the annual carbon emissions shall be less than or equal to 61 percent of the annual site energy consumption of the standard reference design. See Section R401.1 and residential building in Section R202 for Group R-2 scope.
- Energy use derived from simulation analysis shall be expressed in BTU(s) per square foot of conditioned floor area per year.

Total Building Performance



405.3 Documentation

- Documentation of the software used for the performance design and the parameters for the building shall be in accordance with Sections R405.3.1 through R405.3.3. R405.3.1 Compliance software tools. Documentation verifying that the methods and accuracy of the compliance software tools conform to the provisions of this section shall be provided to the code official.



R405.3.1 Compliance software tools

- Documentation verifying that the methods and accuracy of the compliance software tools conform to the provisions of this section shall be provided to the code official.



R405.3.2 Compliance report

- Compliance software tools shall generate a report that documents that the proposed design complies with Section R405.2. A compliance report on the proposed design shall be submitted with the application for the building permit. Upon completion of the building, a confirmed compliance report based upon the confirmed condition of the building shall be submitted to the code official before a certificate of occupancy is issued. Compliance reports shall include information in accordance with Sections R405.3.2.1 and R405.3.2.2.

Total Building Performance

R405.3.2.1 Compliance report for permit application

- A compliance reports submitted with the application for building permit shall include all of the following:
 - 1. Building street address, or other building site identification.
 - 2. The name, organization, and contact information of the individual performing the analysis and generating the compliance report.
 - 3. The name and version of the compliance software tool.
 - 4. Documentation of all inputs entered into the software used to produce the results for the reference design and/or the rated home.
 - 5. A certificate indicating that the proposed design complied with Section R405.2. The certificate shall document the building components' energy specifications that are included in the calculation including: Component-level insulation R-values or U-factors; duct system and building envelope air leakage testing assumptions; and the type and rated efficiencies of proposed heating, cooling, mechanical ventilation, and service water-heating equipment to be installed. If on-site renewable energy systems will be installed, the certificate shall report the type and production size of the proposed system. Additional documentation reporting estimated annual energy production shall be provided.
 - 6. When a site-specific report is not generated, the proposed design shall be based on the worst-case orientation and configuration of the rated home.



Total Building Performance

R405.3.2.2 Compliance report for certificate of occupancy

- A compliance report submitted for obtaining the certificate of occupancy shall include all of the following:
- Building street address, or other building site identification.
- Declaration of the total building performance path on the title page of the energy report and the title page of the building plans.
- A statement bearing the name of the individual performing the analysis and generating the report, along with their organization and contact information, indicating that the as-built building complies with Section R405.2.
- The name and version of the compliance software tool. A site-specific energy analysis report that is in compliance with Section R405.2.
- A final confirmed certificate indicating compliance based on inspection, and a statement indicating that the confirmed rated design of the built home complies with Section R405.2. The certificate shall report the energy features that were confirmed to be in the home, including component level insulation R-values or U-factors; results from any required duct system and building envelope air leakage testing; and the type and rated efficiencies of the heating, cooling, mechanical ventilation, and service water-heating equipment installed.
- Where on-site renewable energy systems have been installed, the certificate shall report the type and production size of the installed system. Additional documentation reporting estimated annual energy production shall be provided.



Total Building Performance



R405.4 Calculation Procedure

- Calculation procedure
- General Specs
- Residence Specifications
- UDRH design
- Modeled Distribution Efficiencies.



Photo courtesy of:
Calculator application, came with PC

Total Building Performance



R405.4 Calculation Procedure

- Calculations of the performance design shall be in accordance with Sections R405.4.1 and R405.4.2.



R405.4.1 General

- Except as specified by this section, the standard reference design and proposed design shall be configured and analyzed using identical methods and techniques.



R405.4.2 Residence specifications

- The standard reference design and proposed design shall be configured and analyzed as specified by Table R405.4.2(1). Table R405.4.2(1) shall include by reference all notes contained in Table R402.1.3.



TABLE ((R402-4-2(4+)) R405.4.2(1))
SPECIFICATIONS FOR THE STANDARD REFERENCE AND PROPOSED DESIGNS

BUILDING COMPONENT	STANDARD REFERENCE DESIGN	PROPOSED DESIGN
Below-grade walls	Type: Mass wall if proposed wall is mass; otherwise wood frame. Gross area: Same as proposed U-factor: From Table R402.1.2 Solar absorptance = 0.75 Emittance = 0.90	As proposed As proposed As proposed As proposed As proposed
Below-grade walls	Type: Same as proposed Gross area: Same as proposed U-factor: From Table R402.1.2, with insulation layer on interior side of walls.	As proposed As proposed As proposed
Above-grade floors	Type: Wood frame Gross area: Same as proposed U-factor: From Table R402.1.2	As proposed As proposed As proposed
Ceilings	Type: Wood frame Gross area: Same as proposed U-factor: From Table R402.1.2	As proposed As proposed As proposed
Roofs	Type: Composition shingle on wood sheathing Gross area: Same as proposed Solar absorptance = 0.75 Emittance = 0.90	As proposed As proposed As proposed As proposed
Attics	Type: Vented with aperture = 1 ft ² per 300 ft ² ceiling area	As proposed
Foundations	Type: Same as proposed foundation wall area above and below-grade Soil characteristics: Same as proposed.	As proposed As proposed
Opaque doors	Area: 40 ft ² Orientation: North U-factor: Same as fenestration from Table R402.1.2.	As proposed As proposed As proposed
Vertical fenestration other than opaque doors ^a	Total area ^b = (a) The proposed glazing area; where proposed glazing area is less than 15% of the conditioned floor area. (b) 15% of the conditioned floor area; where the proposed glazing area is 15% or more of the conditioned floor area.	As proposed
	Orientation: Equally distributed to four cardinal compass orientations (N, E, S & W).	As proposed
	U-factor: From Table R402.1.2	As proposed
	SHGC: From Table R402.1.1 except that for climates with no requirement (NR) SHGC = 0.40 shall be used.	As proposed
	Interior shade fraction: 0.92 - (0.21 × SHGC for the standard reference design) External shading: None	0.92 - (0.21 × SHGC as proposed) As proposed
Skylights	None	As proposed

BUILDING COMPONENT	STANDARD REFERENCE DESIGN	PROPOSED DESIGN
Air exchange rate	Air leakage rate of 4 air changes per hour at a pressure of 0.2 inches w.g. (50 Pa). The mechanical ventilation rate shall be in addition to the air leakage rate and the same as in the proposed design, but no greater than $0.01 \times CFA + 7.5 \times (N_{br} + 1)$ where: CFA = conditioned floor area N _{br} = number of bedrooms - The mechanical ventilation system type shall be the same as in the proposed design. Energy recovery shall not be assumed for mechanical ventilation.	As proposed ^a . The mechanical ventilation rate ^b shall be in addition to the air leakage rate and shall be as proposed.
Mechanical ventilation	None, except where mechanical ventilation is specified by the proposed design, in which case: Annual vent fan energy use: kWh/yr = $(1e_f) \times (0.0876 \times CFA + 65.7 \times (N_{br} + 1))$ where: e _f = the minimum fan efficacy from Table R403.6.1 corresponding to the system type at a flow rate of $0.01 \times CFA + 7.5 \times (N_{br} + 1)$ CFA = conditioned floor area N _{br} = number of bedrooms	As proposed
Internal gains	IGain = $17,900 + 23.8 \times CFA + 4104 \times N_{br}$ (Btu/day per dwelling unit)	Same as standard reference design
Internal mass	An internal mass for furniture and contents of 8 pounds per square foot of floor area.	Same as standard reference design, plus any additional mass specifically designed as a thermal storage element ^c but not integral to the building envelope or structure.
Structural mass	For masonry floor slabs, 80% of floor area covered by R-2 carpet and pad, and 20% of floor directly exposed to room air.	As proposed
	For masonry basement walls, as proposed, but with insulation required by Table R402.1.2 located on the interior side of the walls.	As proposed
	For other walls, for ceilings, floors, and interior walls, wood frame construction.	As proposed
Heating systems ^{d, e}	The standard reference design shall be an air source heat pump meeting the requirements of Section C403 of the WSEC—Commercial Provisions. Capacity: Sized in accordance with Section ((R403-6)) R403.7	As proposed
Cooling systems ^{d, f}	Same system type as proposed. Same system efficiency as required by prevailing minimum federal standard. Capacity: Sized in accordance with Section ((R403-6)) R403.7	As proposed



BUILDING COMPONENT	STANDARD REFERENCE DESIGN	PROPOSED DESIGN
Service water heating ^{d, e, f, g}	The standard reference design shall be a heat pump water ((heating)) heater meeting the standards for Tier 1 of NEEA's Advanced Water Heating Specifications. Use, in units of gal/day = 25.5 + (8.5 x N _{br}) Where N _{br} = number of bedrooms	As proposed Use, in units of gal/day = 25.5 + (8.5 x N _{br}) x (1 - HWDS) Where: N _{br} = number of bedrooms HWDS = factor for the compactness of the hot water distribution system
Thermal distribution systems	Duct insulation: From Section R403.3.3 Duct location: Same as for the standard reference design A thermal distribution system shall be applied to both the standard reference design and the proposed design with the same efficiencies for all systems. Exception: For systems that do not meet the standard reference design (DSE) shall be 1.0	As proposed Use, in units of gal/day = 25.5 + (8.5 x N _{br}) x (1 - HWDS) Where: N _{br} = number of bedrooms HWDS = factor for the compactness of the hot water distribution system
Thermostat	Type: Manual, cooling and heating temperature control	As proposed

BUILDING COMPONENT	STANDARD REFERENCE DESIGN	PROPOSED DESIGN
Service water heating ^{d, e, f, g}	The standard reference design shall be a heat pump water ((heating)) heater meeting the standards for Tier 1 of NEEA's Advanced Water Heating Specifications of Table C404.2. Use, in units of gal/day = 25.5 + (8.5 x N _{br}) Where N _{br} = number of bedrooms	As proposed Use, in units of gal/day = 25.5 + (8.5 x N _{br}) x (1 - HWDS) Where: N _{br} = number of bedrooms HWDS = factor for the compactness of the hot water distribution system
Thermal distribution systems	Duct insulation: From Section R403.3.3	Duct insulation: As proposed

Compactness ratio ¹ factor		
1 story	2 or more stories	HWDS
>60%	>30%	0
>30% to ≤60%	>15% to ≤30%	0.05
>15% to ≤30%	>7.5% to ≤15%	0.10
≤15%	≤7.5%	0.15

For SI: 1 square foot = 0.93 m², 1 British thermal unit = 1055 J, 1 pound per square foot = 4.88 kg/m², 1 gallon (U.S.) = 3.785 L, °C = (°F-32)/1.8, 1 degree = 0.79 rad

a Where required by the code official, testing shall be conducted by an approved party. Hourly calculations as specified in the ASHRAE Handbook of Fundamentals, or the equivalent, shall be used to determine the energy loads resulting from infiltration.

b The combined air exchange rate for infiltration and mechanical ventilation shall be determined in accordance with Equation 43 of 2001 ASHRAE Handbook of Fundamentals, page 26.24 and the "Whole-house Ventilation" provisions of 2001 ASHRAE Handbook of Fundamentals, page 26.19 for intermittent mechanical ventilation.

c Thermal storage element shall mean a component not part of the floors, walls or ceilings that is part of a passive solar system, and that provides thermal storage such as enclosed water columns, rock beds, or phase-change containers. A thermal storage element must be in the same room as fenestration that faces within 15 degrees (0.26 rad) of true south, or must be connected to such a room with pipes or ducts that allow the element to be actively charged.

d For a proposed design with multiple heating, cooling or water heating systems using different fuel types, the applicable standard reference design system capacities and fuel types shall be weighted in accordance with their respective loads as calculated by accepted engineering practice for each equipment and fuel type present.

e For a proposed design without a proposed heating system, a heating system with the prevailing federal minimum efficiency shall be assumed for both the standard reference design and proposed design.

f For a proposed design home without a proposed cooling system, an electric air conditioner with the prevailing federal minimum efficiency shall be assumed for both the standard reference design and the proposed design.

g For a proposed design with a nonstorage-type water heater, a 40-gallon storage-type water heater with the prevailing federal minimum energy factor for without a proposed water heater, a 40-gallon instant heating fuel type shall be assumed for both the standard reference design and proposed design.

h The formula shall be used to determine fenestration area:

0.5 x below-grade boundary wall area) + common wall area) or 0.56, whichever is less.

i The formula shall be used to determine fenestration area:

that bounds the source of hot water and the hot water distribution system, circulation loops, or electric heat traced piping.

per fixture supply piping, in square foot.

d appliances, it is permissible to establish a compactness ratio factor to determine the compactness ratio.

tion system rectangle(s), comparing the area of the standard reference design and proposed design compactness ratio factor.



TABLE R405.2(1)
MANDATORY COMPLIANCE MEASURES FOR TOTAL BUILDING PERFORMANCE

Section*	Title	Comments
General		
R401.3	Certificate	
Envelope		
R402.1.1	Vapor retarder	
R402.2.3	Eave baffle	
R402.2.4.1	Access hatches and doors	
R402.2.10.1	Crawspace wall insulation installations	
R402.4	Air leakage	
R402.5	Maximum fenestration U-factor	
Systems		
R403.1	Controls	
R403.3	Ducts	
R403.4	Mechanical system piping insulation	
R403.5.1	Heated water circulation and temperature maintenance system	
R403.5.3	Drain water heat recovery units	
R403.5.7	Heat pump water heating	
R403.6	Mechanical ventilation	
R403.7	Equipment sizing and efficiency rating	
R403.8	Systems serving multiple dwelling units	
R403.9	Snow melt system controls	
R403.10	Energy consumption of pools and spas	
R403.11	Portable spas	
R403.12	Residential pools and permanent residential spas	
Electrical Power and Lighting		
R404.1	Lighting equipment	
R404.2	Interior lighting controls	

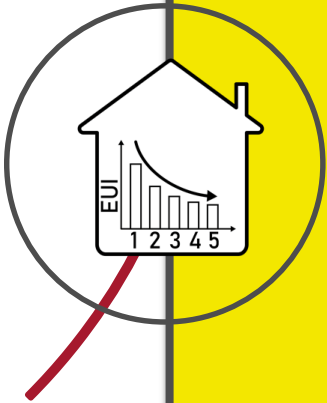
If they are installing the component, then the corresponding code referenced section(s) are mandatory.

a. Reference to a code section includes all the relative subsections except as indicated in the table.



R405.5 Calculation software tools

- Calculation software, where used, shall be in accordance with Sections R405.5.1 through R405.5.3.



R405.5.1 Minimum capabilities

- Calculation procedures used to comply with this section shall be software tools capable of calculating the annual energy consumption of all building elements that differ between the standard reference design and the proposed design and shall include the following capabilities:
 - 1. Calculation of whole-building (as a single zone) sizing for the heating and cooling equipment in the standard reference design residence in accordance with Section R403.6.
 - 2. Calculations that account for the effects of indoor and outdoor temperatures and part-load ratios on the performance of heating, ventilating and air-conditioning equipment based on climate and equipment sizing.
 - 3. Printed code official inspection checklist listing each of the proposed design component characteristics from Table R405.4.2(1) determined by the analysis to provide compliance, along with their respective performance ratings (e.g., R-value, U-factor, SHGC, HSPF, AFUE, SEER, EF, etc.).



R405.5.2 Specific Approval

- Performance analysis tools meeting the applicable sections of Section R405 shall be permitted to be approved. Tools are permitted to be approved based on meeting a specified threshold for a jurisdiction.
- The code official shall be permitted to approve tools for a specified application or limited scope.



R405.5.3 Input Values

When calculations require input values not specified by Sections R402, R403, R404 and R405, those input values shall be taken from an approved source.

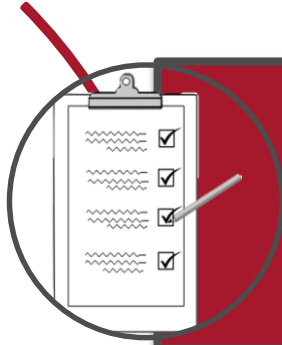
Summary of Section R405
WSEC-Residential 2021
EPCA Edition



- ✓ R405.2 moved to site energy from carbon emissions.
- ✓ Ensure the proper reports are made available to the AHJ for inspection purposes.
- ✓ AHJ approved software. You must get permission for the software you use.

Additional Energy Efficiency Requirements

Chapter 4, section R406 covers the options to meet the WSEC-R through a variety of options and a point/credit system.



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.



R406.2 Performance Based Compliance

- Except as specified by this section, the standard reference design and proposed design shall be configured and analyzed using identical methods and techniques.



Table R406.2 ENERGY EQUALIZATION CREDITS *Single Family Homes*

Heating Options	Description of Primary Heating Source	Supplemental Heating (See footnote b)	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	1.5
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	3.0
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	0.5	2.0

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



Table R406.2 ENERGY EQUALIZATION CREDITS *Multifamily Homes*

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.

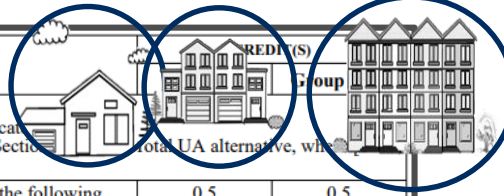
b The gas back-up furnace will operate as fan-only when the heat pump is operating. The heat pump shall operate at all temperatures above 38°F (3.3°C) (or lower). Below that "changeover" temperature, the heat pump would not operate to provide space heating. The gas furnace provides heating below 38°F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

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

R406.3 Additional Energy Efficiency Requirements

- Each dwelling unit in a residential building shall comply with sufficient options from Tables R406.2 and R406.3 so as to achieve the following minimum number of credits:
- 1. Small Dwelling Unit: ~~(3.0)~~ **5.0 credits**
Dwelling units less than 1500 square feet in conditioned floor area with less than 300 square feet of fenestration area. Additions to existing building greater than 500 square feet of heated floor area but less than 1500 square feet.
- 2. Medium Dwelling Unit: ~~(6.0)~~ **8.0 credits**
All dwelling units that are not included in #1, #3 or #4.
- 3. Large Dwelling Unit: ~~(7.0)~~ **9.0 credits**
Dwelling units exceeding 5000 square feet of conditioned floor area.
- 4. 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.
- 5. Additions 150 square feet to 500 square feet: ~~(1.5)~~ **2.0 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.





OPTION	DESCRIPTION	REDU(S)	Group
I. 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 $[(\text{Proposed UA}/\text{Target UA})] >$; the required %UA reduction			
1.1	Prescriptive compliance is based on Table R402.1.3 with the following modifications: Vertical fenestration U = 0.22.	0.5	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 Basement wall R-21 int plus R-5 ci Ceiling and single-rafter or joist-vaulted R-60 advanced 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%.	((0.5)) <u>1.0</u>	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 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%.	((+0)) <u>1.5</u>	1.5
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%.	((+5)) <u>2.5</u>	2.0



2. AIR LEAKAGE CONTROL AND EFFICIENT VENTILATION OPTIONS

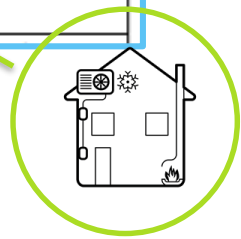
Only one option from Items 2.1 through 2.3 may be selected in this category.

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>	((0-5)) <u>1.0</u>	1.0
2.2	<p>Compliance based on Section R402.4.1.2: Reduce the tested air leakage to 1.5 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 0.20 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 0.75.</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>	((1-4)) <u>1.5</u>	1.5
2.3	<p>Compliance based on Section R402.4.1.2: Reduce the tested air leakage to 0.6 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 0.15 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 0.80. Duct installation shall comply with Section ((R403.3.7)) <u>R403.3.2</u>.</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>	((1-5)) <u>2.0</u>	2.0



OPTION	DESCRIPTION	CREDIT(S)	
		All Other	Group R-2 ^b
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>	((0.5)) 1.0	1.0
2.2	<p>Compliance based on Section R402.4.1: Reduce the tested air leakage to 1.5 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: Reduce the tested air leakage to 0.20 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 0.75.</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>		
2.3	<p>Compliance based on Section R402.4.1: Reduce the tested air leakage to 0.6 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: Reduce the tested air leakage to 0.15 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 0.80. Duct installation shall comply with Section (R403.4-7) R403.1.2.</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>		

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: 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: 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>
2.2	<p>Compliance based on Section R402.4.1: Reduce the tested air leakage to 1.5 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: Reduce the tested air leakage to 0.20 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 0.75.</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>
2.3	<p>Compliance based on Section R402.4.1: Reduce the tested air leakage to 0.6 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: Reduce the tested air leakage to 0.15 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 0.80. Duct installation shall comply with Section (R403.4-7) R403.1.2.</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>
3. HIGH EFFICIENCY HVAC EQUIPMENT OPTIONS Only one option from Items 3.1 through 3.8 may be selected in this category. Item 3.9 may be taken with Items 3.1 or 3.3 ^a only.	





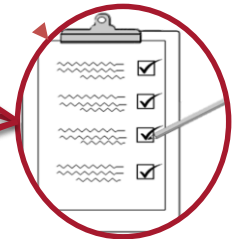
3. HIGH EFFICIENCY HVAC EQUIPMENT OPTIONS

Only one option from Items 3.1 through [3-8-3.10](#) may be selected in this category. Item [3-93.11](#) may be taken with Items 3.1 or 3.3^c only.

OPTION	DESCRIPTION	CREDIT(S)	
		All Other	Group R-2 ^b
3.1 ^a	<p>For a System Type 1 in Table R406.2: Energy Star rated (U.S. North) gas or propane furnace with minimum AFUE of 95%.</p> <p>or</p> <p>Energy Star rated (U.S. North) gas or propane boiler with minimum AFUE of 90%</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>	1.0	1.0
3.2 ^a	<p>For secondary heating system serving System Type 2 in Table R406.2: Energy Star rated (U.S. North) Gas or propane furnace with minimum AFUE of 95%</p> <p>or</p> <p>Energy Star rated (U.S. North) Gas or propane boiler with minimum AFUE of 90%.</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>	0.5	0.5



3.3 ^{a,c,d}	<p>Air-source centrally ducted heat pump with minimum 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>	0.5	N/A
3.4 ^{a,d}	<p>Closed-loop ground source heat pump; with a minimum COP of 3.3</p> <p>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>	1.5	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 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>	1.5	2.0
3.6 ^{a,d}	<p>Air-source, centrally ducted heat pump with minimum HSPF of 11.0.</p> <p>A centrally ducted air source cold climate variable capacity heat pump (cc VHP) found on the NEEP cc VCHP qualified product list with a minimum of 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>	1.0	N/A





Appendix RC Courtesy of SBCC: Energy Code EPCA C102

APPENDIX RC EXTERIOR DESIGN CONDITIONS

As required by Sections C302.2 and R302.2, the heating or cooling outdoor design temperatures shall be selected from Table C-1.

TABLE C-1
OUTDOOR DESIGN TEMPERATURES

Location	Outdoor Design Temp Heating (°F)	Outdoor Design Temp Cooling (°F)
Abenckee 20NNE	25	83
Anacortes	24	72
Anatone	-4	89
Auburn	25	84
Bathground	19	91
Bellevue	24	83
Bellingham 2N	19	78
Blain	17	73
Bremerton	29	83
Burlington	19	77
Chablis	21	87
Chelan	10	89
Cheney	4	94
Chenaw	-11	81
Clarkston	10	94
Cle Elum	1	91
Colden INW	2	94
Columbia AP	-2	92
Concord	19	83
Cornell 4NNE	6	100
Cougar SE	25	93
Dallasport AP	14	99
Darrington RS	13	85
Davenport	5	92
Edmonds	24	82
Ellensburg AP	2	90
Elma	24	88
Ephrata AP	7	97
Everett Paine AFB	21	79
Forks 1E	23	81
Glacier RS	13	82
Gleason (Koomas)	18	89
Gokendale	7	94
Grays River Hatchery	24	86

Location	Outdoor Design Temp Heating (°F)	Outdoor Design Temp Cooling (°F)
Greenwater	14	84
Groto	21	84
Haquam AP	26	79
Ischlam 2NW	0	92
John Day Dam	19	100
Long Beach 3NNE	25	77
Longview	24	87
Lower Granite Dam	14	98
Lower Monument Dam	18	103
Marvsville	23	79
Metline Falls	-1	89
Methow 2W	1	89
Newpalem 2S	-4	93
Newhalem	19	89
Newport	-5	92
Nordquest	2	92
Oak Harbor	16	74
Odeas	-7	100
Ojaga 2SE	24	71
Olympia AP	17	85
Orisk 2NW	3	90
Oroville	5	93
Othello	9	98
Packwood	16	90
Plain	-3	89
Pleasant View	16	98
Pomero	3	95
Port Angeles	28	75
Port Townsend	25	76
Prosser	12	97
Puyallup	19	86
Quilcene 2SW	23	83
Quinalt RS	25	84

Location	Outdoor Design Temp Heating (°F)	Outdoor Design Temp Cooling (°F)
Rainier Longview	15	85
Paradise RS	8	71
Raymond	28	81
Redmond	17	83
Republic	-9	87
Richland	11	101
Ritzville	6	99
Saltus Pass	10	90
Seattle SeaTac AP	24	83
Sedro Woolley 1E	19	78
Sequim	23	78
Shelton	23	85
Smyrna	8	102
Snohomish	21	81
Snoqualmie Pass	6	80
Spokane AP	4	92
Spokane CO	10	96
Stampano Pass	7	76
Stevedin 3NW	12	85
Steverson Pass	6	77
Tacoma CO	29	82
Tanah Island	31	63
Toledo AP	17	84
Vancouver	22	88
Vashon Island	28	78
Walla Walla AP	6	96
Waterville	1	88
Wellpinit	1	93
Wenatchee CO	10	92
Whidbey Island	11	71
Willapa Harbor	26	81
Wilson Creek	3	96
Wintthrop 1WSW	-12	91
Yakima AP	11	94

NEEP's Heat Pump List (NEEP List)



NEEP'S COLD CLIMATE AIR SOURCE

Heat Pump List

Search Products Consumer and Installer Resources About ASHP Initiative About NEEP Login

Product Type ¹

Ducting Configuration

All Product Typ v

All Ducting Cor v

Brand

All Brands v

AHRI, Model, Unit ¹

AHRI, Model or Ur v

Heating Capacity

47°F Rated Btu/h ¹

0 80000

Heating Capacity 5°F Max Btu/h ¹

0 80000

ENERGY STAR Certified

ENERGY STAR

ENERGY STAR Cold Climate

Eligible for Federal Tax Credit ¹

All Regions

North

Southeast

Southwest

Advanced Search - Sizing for Heating



Energy credit option	New HSPF 2 value	Old HSPF value
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 \leq 24,000 Btu (except footnote A)	8.1	9



3.3 ^{a,c,d}	<p>Air-source centrally ducted heat pump with minimum 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>	0.5	N/A
3.4 ^{a,d}	<p>Closed-loop ground source heat pump; with a minimum COP of 3.3</p> <p>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>	1.5	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 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>	1.5	2.0
3.6 ^{a,d}	<p>Air-source, centrally ducted heat pump with minimum HSPF of 11.0.</p> <p>A centrally ducted air source cold climate variable capacity heat pump (cc VHP) found on the NEEP cc VCHP qualified product list with a minimum of 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>	1.0	N/A



OPTION	DESCRIPTION	CREDIT(S)	
		All Other	Group R-2 ^b
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 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 to claim this credit shall be 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>	2.0	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>	1.0	N/A



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)

3.9	<u>Gas-fired heat pump(s) meeting ANSI Z21.40.2 and Z21.40.4 or CSA, with a minimum UEF of 1.15.</u> <u>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.</u>	1.5	1.5
3.10 ^f	<u>Combination water heating and space heating system shall include one of the following:</u> <u>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.</u> <u>or</u> <u>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.</u> <u>or</u> <u>For R-2 Occupancy, gas-fired heat pump(s) meeting ANSI Z21.40.2 and Z21.40.4 or CSA,</u>	2.5	2.5

OPTION	DESCRIPTION	CREDIT(S)	
		All Other	Group R-2 ^b
	<u>with a minimum UEF of 1.15, shall serve all units.</u> <u>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.</u>		
3.9 3.11 ^c	Connected thermostat meeting ENERGY STAR Certified Smart Thermostats/EPA ENERGY STAR specifications. To qualify to claim this credit, the building permit drawings shall specify the option being selected and shall specify the thermostat model.	0.5	0.5



4. HIGH EFFICIENCY HVAC DISTRIBUTION SYSTEM OPTIONS			
4.1	<p>HVAC equipment and associated duct system(s) installation shall comply with the requirements of Section R403.3.2.</p> <p>Electric resistance heat, hydronic heating and ductless heat pumps are not permitted under this option.</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 shall show the location of the heating and cooling equipment and all the ductwork.</p>	0.5	N/A

Ducts in Dropped Ceilings



Scope Description Success Climate Training Compliance Retrofit More Sales


Scope

Install ducts in dropped ceilings or “fur-down” duct chases to keep the ducts within the home’s thermal envelope.

- Install drywall at the ceiling plane before the chase is framed to form a continuous air barrier between the top of the chase and the unconditioned attic or floor cavity above.
- Install chase framing.
- Install the sealed, insulated ducts.
- Install drywall on chase sides and bottom when installing drywall in remainder of the house.

Several trades are critical to the success of this technique:

- **HVAC Designers** - Design a compact duct layout that does not cross load bearing walls. Use ACCA Manual D to determine the duct size needed.
- **Framers** - Construct any non-load bearing walls that will serve as one side of the chase with a gap of 3/4" between the top plate of the wall and the bottom chord of the attic trusses so that drywall can be installed over the top plates to form a continuous ceiling for the duct chase. Construct remaining duct chase after chase ceiling drywall is installed.
- **Drywallers** - Install drywall above duct chase location before framing the chase and before installing the ducting. The remaining drywall in the room will be installed after the duct and chase framing are installed.
- **Plumbers and Electricians** - Do not use the duct chase as a chase for electrical wiring or plumbing, and do not cut holes through the chase walls.
- **All Trades** - Participate in a pre-construction meeting to understand construction sequencing steps for this technique, which is further described in the Description tab of this guide.



The drywall above the dropped ceiling duct chase extends beyond adjoining top plates for a continuous air barrier



5. EFFICIENT WATER HEATING OPTIONS

Only one option from Items 5.3 through ~~(5.5)~~ 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>	0.5	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>	0.5	0.5



5. EFFICIENT WATER HEATING OPTIONS

Only one option from Items 5.3 through ~~(5.5)~~ 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: <u>Energy Star rated gas or propane water heater with a minimum UEF of 0.80.</u></p> <p><u>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.</u></p>	<u>0.5</u>	<u>0.5</u>
<u>5.4</u>	<p>Water heating system shall include one of the following: <u>Energy Star rated gas or propane water heater with a minimum UEF of 0.91.</u></p> <p>or</p> <p>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</p> <p>or</p> <p>Water heater heated by ground source heat pump meeting the requirements of Option (3.3) <u>3.4.</u></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>	1.0	1.0



OPTION	DESCRIPTION	CREDIT(S)	
		All Other	Group R-2 ^b
(5-4) 5.5	<p>Water heating system shall include one of the following: <u>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.</u></p> <p>or</p> <p><u>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.</u></p> <p>or</p> <p><u>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.</u></p> <p><u>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.</u></p>	1.5	1.5
5.6	<p>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.</p> <p>or</p> <p>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.</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>	2.0	2.5



<p>((5-5)) <u>5.7</u></p>	<p>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.</p> <p>or</p> <p>For R-2 Occupancy, electric heat pump water heater(s), meeting the standards for Tier III of NEEA's advanced water heating specification</p>	<p>2.5</p>	<p>3.0</p>
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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)

<p>5.8</p>	<p><u>Combination water heating and space heating system shall include one of the following:</u> <u>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.</u></p> <p>or</p> <p><u>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.</u></p> <p>or</p> <p><u>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.</u></p> <p><u>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.</u></p>	<p><u>TBD</u></p>	<p><u>TBD</u></p> <p>2.5 Credits</p>
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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 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:
For solar electric systems, the design shall be demonstrated to meet this requirement using the National Renewable Energy Laboratory calculator PVWATTS or approved (~~alternate~~) alternative by the code official.

Documentation noting solar access shall be included on the plans.

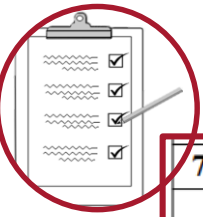
For wind generation projects designs shall document annual power generation based on the following factors:

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.

0.5 – 4.5

0.5 – 4.5



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>	0.5	1.5
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^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 3.9 can only be taken with Options 3.1 and 3.3.

^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 3.11 may only be taken with Efficient Water Heating Options 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 system shall be in accordance with Section R403.5.7.

^c Option ~~3.93.11~~ can only be taken with Options 3.1 and 3.3. To qualify to claim option ~~3.93.11~~ 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 ~~3.113.10~~ may only be taken with Efficient Water Heating Options 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 system shall be in accordance with Section R403.5.7.

Chapter 4

WSEC - Residential Energy Code & 2021 Changes:

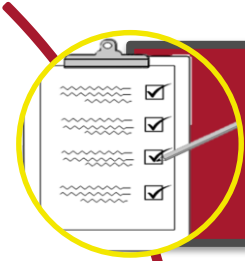
Summary of Section R406 WSEC - Residential 2021 EPCA Edition



- ✓ 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

Passive House & Certification.

Chapter 4, section R407 covers the use of passive house certification to demonstrate compliance with the WSEC-R code.



R-407.1 General

- 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.



R407.2 Passive House Institute U.S. (PHIUS)

- Passive House Institute U.S. (PHIUS)
- Prior to the issuance of a building permit, the following items must be provided to the code official:
 - A list of compliance features.
 - A PHIUS precertification letter. Prior to the issuance of a certificate of occupancy, the following item must be provided to the code official:
 - A PHIUS+ 2018 (or later) project certificate.



R 401.3 Passive House Institute (PHI)

- Projects shall comply with Low Energy Building Standard, version 9f or later, including performance calculations by PHI-approved software. Projects shall also comply with the provisions of Section R401 through R404. R407.3.1 PHI documentation. Prior to the issuance of a building permit, the following items must be provided to the code official:
 1. A list of compliance features.
 2. A statement from a passive house certifier that the modeled energy performance is congruent with the plans and specifications, and that the modeled performance meets said standard. Prior to the issuance of a certificate of occupancy, the following item must be provided to the code official:
 1. A PHI Low Energy Building project certificate

Chapter 5

WSEC - Residential Energy Code & 2021 Changes:

What is Chapter 5?

Chapter 5 is Existing Buildings, “Old school stuff”.

Chapter 5 is everything existing. It covers additions of new spaces, alterations or change of use of exiting spaces as well as repairs and maintenance.

General – R501

Additions– R502

Alterations – R303

Repairs- R404

Change of use- R405

Examples of Accessory Dwelling Units (ADUs)

ADUs in blue; main residence in white

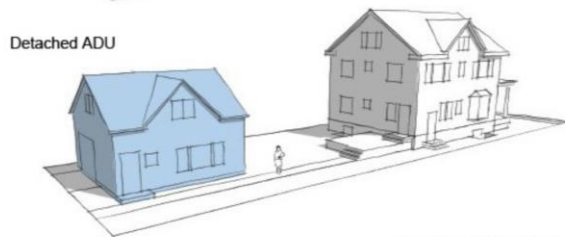
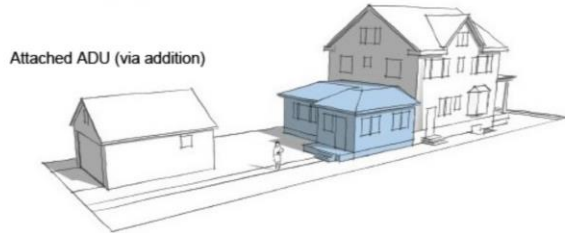
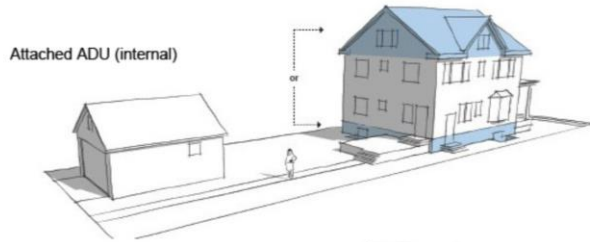


Image credit: City of Saint Paul, MN

General – R501.1 – 501.6

Scope of work

General & Thermostats for ADU's

Compliance & defines Existing Unit types

Maintenance Historic Buildings

Additions– R502.1 – 502.4

General & small additions

Change of use

Prescriptive compliance

HVAC Systems, Hot Water, & Lighting

Existing Plus Compliance

Alterations – R503.1 -503.1.4

General & Building Envelope requirements, &

Replacement of Fenestration

HVAC and Service Hot Water Heating Requirements.

Repairs- R504.1 & R504.2

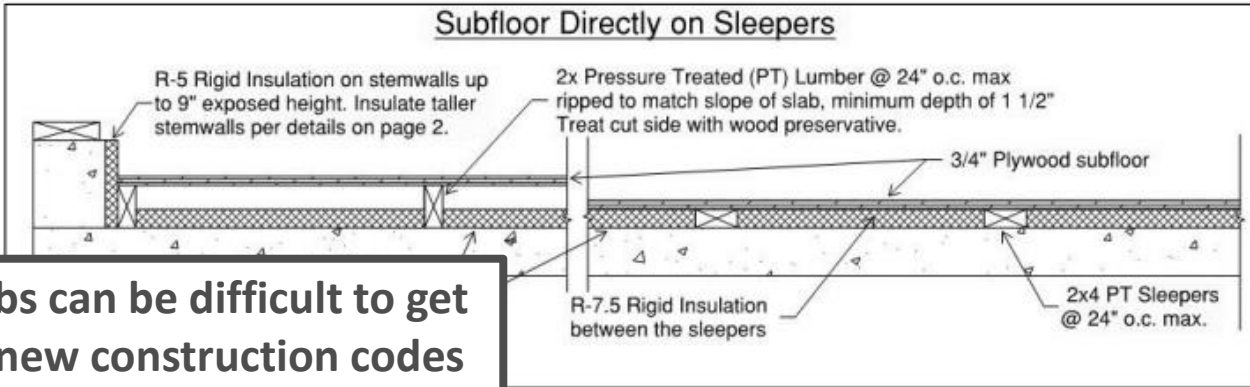
General and Application

Change of Use- R505

Covers the code section requirements for a change of use.

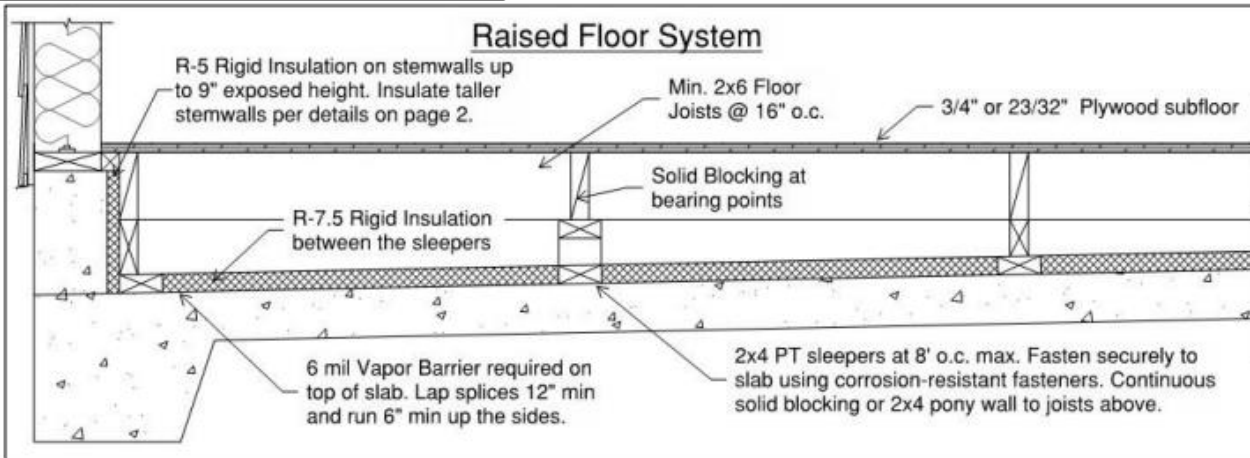


Subfloor Directly on Sleepers



Existing slabs can be difficult to get convert to new construction codes

Raised Floor System



Remodel / Alteration Worksheet

Will you be exposing the walls?

Yes No

If yes,

- 2 X 4 wall studs require R-15 insulation
- 2 X 6 wall studs require R-21 insulation
- If siding is replaced C.I. equal to R-5 will need installed under the siding.

Will the roof/ceiling framing cavities or attic be exposed?

Yes No

If yes,

- Exposed roof or ceiling assemblies must be insulated -
 - Vaulted ceilings, Insulate to the full depth of the framing member
 - Flat ceilings, install R-60 insulation or what the attic space can accommodate based on the roof pitch

Will the will the floor framing cavities be exposed?

Yes No

If yes,

- Exposed floor cavities must be insulated to R-30

Are the windows and/or doors being replaced?

Yes No

If yes,

- New windows and doors (+frames) must have an area weighted average U-factor of ≤ 0.30

Will the heating or cooling system be replaced?

Yes No

If yes,

- New equipment must meet current requirements and the ducts need to be tested

Will the hot water system be altered?

Yes No

If yes,

- New water heating equipment must meet current code requirements

Are more than 10% of the light fixtures being changed?

Yes No

If yes,

- 100% of all lamps must be high efficacy

R503.2 Change in space conditioning. Any nonconditioned or low-energy space that is altered to become conditioned space shall be required to be brought into full compliance with this (WSEC-R) code.

R503.1.1 Building envelope.

Building envelope assemblies that are part of the alteration shall comply with Section R402.1.3 or R402.1.5, Sections R402.2.1 through R402.2.11, R402.3.1, R402.3.2, R402.3.5 and R402.4.2.

Exception: The following alterations need not comply with the requirements for new construction provided the energy use of the building is not increased:

1. Storm windows installed over existing fenestration.
2. Existing ceiling, wall or floor cavities exposed during construction provided that these cavities are filled with insulation. 2x4 framed walls shall be insulated to a minimum of R-15 and 2x6 framed walls shall be insulated to a minimum of R-21.
3. Construction where the existing roof, wall or floor cavity is not exposed.
4. Roof recover.
5. Roofs without insulation in the cavity and where the sheathing or insulation is exposed during reroofing shall be insulated either above or below the sheathing.
6. Surface-applied window film installed on existing single pane fenestration assemblies to reduce solar heat gain provided the code does not require the glazing fenestration to be replaced.

R503.1.1.1 Replacement fenestration.

Where some or all of an existing fenestration unit is replaced with a new fenestration product, including sash and glazing, the replacement fenestration unit shall meet the applicable requirements for U-factor and SHGC in Table R402.1.3.

Where more than one replacement fenestration unit is being installed, an area-weighted average of the U-factor and SHGC of all replacement fenestration shall be permitted to be used to demonstrate compliance.

R503.1.2 Heating and cooling systems.

New heating, cooling and duct systems that are part of the alteration shall comply with Section R403.

Exceptions:

1. Where ducts from an existing heating and cooling system are extended, duct systems with less than 40 linear feet in unconditioned spaces shall not be required to be tested in accordance with Section R403.2.2
2. Existing duct systems constructed, insulated or sealed with asbestos.

R502.1.1.2 Heating and cooling systems.

New heating, cooling and duct systems that are part of the addition shall comply with Section R403.

Exception:

The following need not comply with the testing requirements of Section R403.3.3:

1. Additions of less than 750 square feet.
2. Duct systems that are documented to have been previously sealed as confirmed through field verification and diagnostic testing in accordance with procedures in WSU RS-33.
3. Ducts with less than 40 linear feet in unconditioned spaces.
4. Existing duct systems constructed, insulated or sealed with asbestos.

R503.1.4 Lighting.

New lighting systems that are part of the alteration shall comply with Section R404.1.

Exception: Alterations that replace less than 10 percent of the luminaires in a space, provided that such alterations do not increase the installed interior lighting power.

R503.1.3 Service hot water systems.

New service hot water systems that are part of the alteration shall comply with Section R403.5.

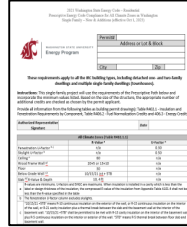
Summary of Chapter 5
WSEC – Residential 2021
EPCA Edition:



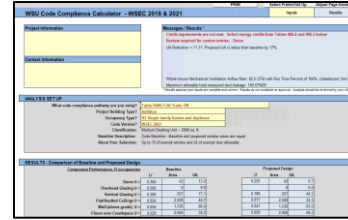
- ✓ 150 sf exception to R406.2 and R406.3 Credit Selection
 - No duct testing
 - No air barrier test required
- ✓ New language about remodeling and equipment:
 - Additions *shall not create an unsafe or hazardous condition or overload existing building systems.....*
- ✓ **R502.3.1.1 Existing ceilings with attic spaces.**
Where an addition greater than 150 square feet (9.2 m²) adjoins existing ceilings with attic spaces, the existing attic spaces shall comply with Section R402.
- ✓ **R502.4 Existing plus addition compliance Total Building Performance.**

Single Family or Multifamily Worksheets

- Prescriptive
- UA Alternative
- 405.3 Modeling



or



WSU WSEC-R 2021 Compliance tools

HVAC Calculator

- ACCA Manuals
- Approved alternative
- Simple Heat load
- Not usable with cooling units



Image courtesy of ACCA

or

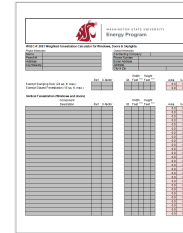


or



Glazing Schedule

- Included with the C3 Tool
- Glazing Schedule Form

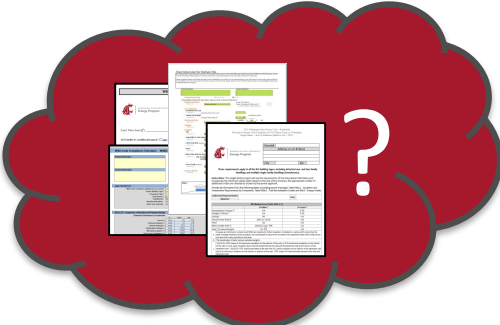
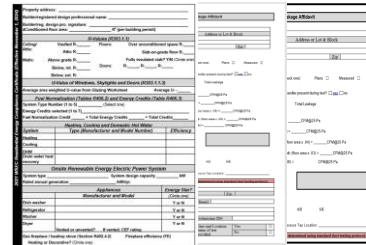


or



Final Testing Forms

- Air Barrier
- Duct Leakage
- Ventilation
- "Code Sticker"



Single Family Prescriptive

2021 Washington State Energy Code – Residential
Prescriptive Energy Code Compliance for All Climate Zones in Washington
Single Family – New & Additions (effective March 15, 2024)



WASHINGTON STATE UNIVERSITY
Energy Program

Permit #	Address or Lot & Block	
City	Zip	

These requirements apply to all the IRC building types, including detached one- and two-family dwellings and multiple single-family dwellings (townhouses).

Instructions: This single-family project uses the requirements of the Prescriptive Path below to incorporate the minimum values listed. Based on the conditioned floor area of the structure, the number of required additional credits must be selected by the permit applicant.

Provide all information from the following tables as building permit drawings: Table R402.1.2 - Insulation and Fenestration Requirements by Component, Table R406.2 - Fuel Normalization Credits and R406.3 - Energy Credits.

Authorized Representative Signature	Date
-------------------------------------	------

All Climate Zones Table 402.1.1		
	R-Value *	U-Factor *
Fenestration U-Factor ^{a,1}	n/a	0.30
Skylight U-Factor ^a	n/a	0.50
Ceiling ^a	60	n/a
Wood Frame Wall ^{b,1}	20-5 or 13-10	n/a
Floor	30	n/a
Below Grade Wall ^{b,2}	10/15/21 in. + S1B	n/a
Slab ^{b,3} R-Value & Depth	10, 4 ft.	n/a

^a R values are minimums. U-factors and SHGC are maximums. When insulation is installed in a cavity which is less than the label or design thickness of the insulation, the compressed R-value of the insulation from Appendix Table A103.4 shall not be less than the R-value specified in the table.

^b The fenestration U-factor column excludes skylights.

¹ 10/15/21 + S1B means R-10 continuous insulation on the exterior of the wall, or R-15 continuous insulation on the interior of the wall, or R-21 cavity insulation plus a thermal break between the slab and the basement wall at the interior of the basement wall. *10/15/21 + S1B* shall be permitted to be met with R-13 cavity insulation on the interior of the basement wall plus R-5 continuous insulation on the interior or exterior of the wall. *S1B* means R-5 thermal break between floor slab and basement wall.

² R-10 continuous insulation is required under heated slab on grade floors. See Section R402.2.1.1.

³ For single rafter- or joist-vented ceilings, the insulation may be reduced to R-38 if the full insulation depth extends over the top plate of the exterior wall.

⁴ R-7.5 continuous insulation installed over an existing slab is deemed to be equivalent to the required perimeter slab.

⁵ Insulation when applied to existing slabs complying with Section R503.1.1. If foam plastic is used, it shall meet the requirements for thermal barriers protecting foam plastics.

⁶ For log structures developed in compliance with Standard E1-400, log walls shall meet the requirements for climate zone 5 of ICC 400.

⁷ Intermediate framing denotes framing and insulation as described in Section A103.2.2 including standard framing 16 inches on center, 78 percent of the wall cavity insulated and headers insulated with a minimum of R-10 insulation.

⁸ The first value is cavity insulation, the second value is continuous insulation. Therefore, as an example, "R13+10" means R-13 cavity insulation plus R-10 continuous insulation.

2021 Washington State Energy Code – Residential
Prescriptive Energy Code Compliance for All Climate Zones in Washington
Single Family – New & Additions (effective March 15, 2024)

j A maximum U-factor of 0.32 shall apply to vertical fenestration products installed in buildings located above 4000 feet in elevation above sea level, or in windborne debris regions where protection of openings is required under Section R301.2.1.2 of the International Residential Code.

Each dwelling unit in a residential building shall comply with sufficient options from Table R406.2 (fuel normalization credits) and Table 406.3 (energy credits) to achieve the following minimum number of credits. To claim this credit, the building permit drawings shall specify the option selected and the maximum tested building air leakage, and show the qualifying ventilation system and its control sequence of operation.

- Small Dwelling Unit: **5.0 credits**
Dwelling units less than 1500 square feet in conditioned floor area with less than 300 square feet of fenestration area. Additions to existing building greater than 500 square feet of heated floor area but less than 1500 square feet.
- Medium Dwelling Unit: **8.0 credits**
All dwelling units that are not included in #1, #3 or #4.
- Large Dwelling Unit: **9.0 credits**
Dwelling units exceeding 5000 square feet of conditioned floor area.
- Dwelling units serving Group R-2 occupancies: **6.5 credits**
Section R401.1 and residential building Section R202 for Group R-2.
- Additions 150 square feet to 500 square feet: **2.0 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

Before selecting your credits on this Summary table, review the details in Table 406.3 (Single Family), on page 4.

Table R406.2 ENERGY EQUALIZATION CREDITS		
Heating Options	Description of Primary Heating Source	Credits – select ONE heating 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). 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(5b) found in the 2021 WSEC- COMMERCIAL ENERGY CODE	0 <input type="checkbox"/>
2	For heating system based on electric resistance only (either forced air or Zonal)	1.5 <input type="checkbox"/>
3	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/S90	0.5 <input type="checkbox"/>
4 ^a	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	3.0 <input type="checkbox"/>
5		2.0 <input type="checkbox"/>

- 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 “changepover” 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 the HVAC system are included in Table R406.3.

2021 Washington State Energy Code – Residential
Prescriptive Energy Code Compliance for All Climate Zones in Washington
Single Family – New & Additions (effective March 15, 2024)

Summary of Table R406.3			
Energy Options	Energy Credit Option Descriptions	Credits – select ONE energy option from each category ^a	Comments:
1.1	Efficient Building Envelope	0.5 <input type="checkbox"/>	
1.2	Efficient Building Envelope	1.0 <input type="checkbox"/>	
1.3	Efficient Building Envelope	1.5 <input type="checkbox"/>	
1.4	Efficient Building Envelope	2.5 <input type="checkbox"/>	
2.1	Air Leakage Control and Efficient Ventilation	1.0 <input type="checkbox"/>	
2.2	Air Leakage Control and Efficient Ventilation	1.5 <input type="checkbox"/>	
2.3	Air Leakage Control and Efficient Ventilation	2.0 <input type="checkbox"/>	
3.1 ^a	High Efficiency HVAC	1.0 <input type="checkbox"/>	
3.2 ^a	High Efficiency HVAC	0.5 <input type="checkbox"/>	
3.3 ^{a,4}	High Efficiency HVAC	0.5 <input type="checkbox"/>	
3.4 ^{a,6}	High Efficiency HVAC	1.5 <input type="checkbox"/>	
3.5 ^{a,7}	High Efficiency HVAC	1.5 <input type="checkbox"/>	
3.6 ^a	High Efficiency HVAC	1.0 <input type="checkbox"/>	
3.7 ^{a,4,6}	High Efficiency HVAC	2.0 <input type="checkbox"/>	
3.8 ^{a,6}	High Efficiency HVAC	1.0 <input type="checkbox"/>	
3.9 ^a	High Efficiency HVAC	0.5 <input type="checkbox"/>	
3.10	High Efficiency HVAC	1.5 <input type="checkbox"/>	
3.11	High Efficiency HVAC	2.5 <input type="checkbox"/>	
4.1	High Efficiency HVAC Distribution System	0.5 <input type="checkbox"/>	
5.1 ^a	Efficient Water Heating	0.5 <input type="checkbox"/>	
5.2	Efficient Water Heating	0.5 <input type="checkbox"/>	
5.3	Efficient Water Heating	0.5 <input type="checkbox"/>	
5.4	Efficient Water Heating	1.0 <input type="checkbox"/>	
5.5	Efficient Water Heating	1.5 <input type="checkbox"/>	
5.6	Efficient Water Heating	2.0 <input type="checkbox"/>	
5.7	Efficient Water Heating	2.5 <input type="checkbox"/>	
5.8	Efficient Water Heating	TBD <input type="checkbox"/>	
6.1 ^a	Renewable Electric Energy (4.5 credits max)	0.5-4.5 <input type="checkbox"/>	
7.1	Appliance Package	0.5 <input type="checkbox"/>	
		Total Credits	

- 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 3.9 can only be taken with Options 3.1 and 3.3. To qualify to claim Option 3.8 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.

Multifamily Prescriptive

2021 Washington State Energy Code – Residential Prescriptive Energy Code Compliance for All Climate Zones in Washington Multifamily – New & Additions (effective March 15, 2024)

2021 Washington State Energy Code – Residential
Prescriptive Energy Code Compliance for All Climate Zones in Washington
Multifamily – New & Additions (effective March 15, 2024)



WASHINGTON STATE UNIVERSITY
Energy Program

Permit#	Address or Lot & Block
City	Zip

These requirements apply to all Dwelling units serving Group R-2 occupancies. See Section R402 residential building in Section R202 for Group R-2 scope.

Instructions:

This multifamily project uses the requirements of the Prescriptive Path below to incorporate minimum values listed, additional credits must be selected by the permit applicant.

Provide all information from the following tables as building permit drawings: Table R402.1 Insulation and Fenestration Requirements by Component, Table R406.2 - Energy Equalization and R406.3 - Energy Credits.

Authorized Representative Signature	Date
-------------------------------------	------

All Climate Zones Table 402.1.3		
	R-Value *	U-Factor *
Fenestration U-Factor ^{a,1}	n/a	0.30
Skylight U-Factor ¹	n/a	0.50
Ceiling ²	60	n/a
Wood Frame Wall ^{3,4}	20+5 or 13+10	n/a
Floor	30	n/a
Below Grade Wall ^{5,6}	10/15/21 lin + 5TB	n/a
Slab ^{7,8} R-Value & Depth	10, 4 ft	n/a

- R-values are minimums. U-factors and SHGC are maximums. When insulation is installed in a cavity which is less than the R-value or design thickness of the insulation, the compressed R-value of the insulation from Appendix Table A101.4 shall be used.
- a. The fenestration U-factor column excludes skylights.
- b. The fenestration U-factor column excludes skylights.
- c. "10/15/21 +5TB" means R-10 continuous insulation on the exterior of the wall, or R-15 continuous insulation on the exterior of the wall, or R-21 cavity insulation plus a thermal break between the slab and the basement wall at the interior of the basement wall. "10/15/21 +5TB" shall be permitted to be met with R-13 cavity insulation on the interior of the base plus R-8 continuous insulation on the interior or exterior of the wall. "5TB" means R-5 thermal break between floor and basement wall.
- d. R-10 continuous insulation is required under heated slab on grade floors. See Section R402.2.9.1.
- e. For single rafter- or joist-raftered ceilings, the insulation may be reduced to R-38 if the full insulation depth extends to the top plate of the exterior wall.
- f. R-7.5 continuous insulation installed over an existing slab is deemed to be equivalent to the required perimeter slab insulation when applied to existing slabs complying with Section E503.1.1. If foam plastic is used, it shall meet the requirements for thermal barriers protecting foam plastics.
- g. For log structures developed in compliance with Standard ICC 400, log walls shall meet the requirements for climate zone 6 of ICC 400.
- h. Int. (intermediate framing) denotes framing and insulation as described in Section A103.2.2 including standard framing inches on center, 78 percent of the wall cavity insulated and headers insulated with a minimum of R-10 insulation.

- i. The first value is cavity insulation, the second value is continuous insulation. Therefore, as an example, "R13+10" means R-13 cavity insulation plus R-10 continuous insulation.
- j. A maximum U-factor of 0.32 shall apply to vertical fenestration products installed in buildings located above 4000 feet in elevation above sea level, or in windborne debris regions where protection of openings is required under Section R301.2.1.2 of the International Residential Code.

Each dwelling unit in a residential building shall comply with sufficient options from Table R406.2 (fuel normalization credits) and Table 406.3 (energy credits) to achieve the following minimum number of credits. To claim this credit, the building permit drawings shall specify the option selected and the maximum tested building air leakage, and show the qualifying ventilation system and its control sequence of operation.

4. Dwelling units serving Group R-2 occupancies: 6.5 credits
Section R401.1 and residential building Section R202 for Group R-2.
5. Additional 150 square feet to 500 square feet: 2.0 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.

Before selecting your credits on this Summary table, review the details in Table 406.3 (Single Family), on page 4.

Table R406.2 ENERGY EQUALIZATION CREDITS		
Heating Options	Description of Primary Heating Source	Credits select OR heating 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)	0 <input type="checkbox"/>
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) found in the 2021 WSEC-COMMERCIAL ENERGY CODE	0 <input type="checkbox"/>
3	For heating system based on electric resistance only (either forced air or Zonal)	-0.5 <input type="checkbox"/>
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	2.0 <input type="checkbox"/>
5	For heating system based on electric resistance with: <ol style="list-style-type: none"> Inverter-driven ductless mini-split heat pump system installed in the largest zone in the dwelling, or With 2kW or less total installed heating capacity per dwelling 	0 <input type="checkbox"/>

- 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 the HVAC system are included in Table R406.3.

2021 Washington State Energy Code – Residential Prescriptive Energy Code Compliance for All Climate Zones in Washington Multifamily – New & Additions (effective March 15, 2024)

Summary of Table R406.3

Energy Options	Energy Credit Option Descriptions	Credits - select ONE energy option from each category ^a	Comments:
1.1	Efficient Building Envelope	0.5 <input type="checkbox"/>	
1.2	Efficient Building Envelope	1.0 <input type="checkbox"/>	
1.3	Efficient Building Envelope	1.5 <input type="checkbox"/>	
1.4	Efficient Building Envelope	2.0 <input type="checkbox"/>	
2.1	Air Leakage Control and Efficient Ventilation	1.0 <input type="checkbox"/>	
2.2	Air Leakage Control and Efficient Ventilation	1.5 <input type="checkbox"/>	
2.3	Air Leakage Control and Efficient Ventilation	2.0 <input type="checkbox"/>	
3.1 ^a	High Efficiency HVAC	1.0 <input type="checkbox"/>	
3.2 ^a	High Efficiency HVAC	0.5 <input type="checkbox"/>	
3.3 ^{a,c,d}	High Efficiency HVAC	0 <input type="checkbox"/>	
3.4 ^{a,d}	High Efficiency HVAC	1.0 <input type="checkbox"/>	
3.5 ^a	High Efficiency HVAC	2.0 <input type="checkbox"/>	
3.6 ^a	High Efficiency HVAC	0 <input type="checkbox"/>	
3.7 ^{a,d}	High Efficiency HVAC	3.0 <input type="checkbox"/>	
3.8 ^{a,d}	High Efficiency HVAC	0 <input type="checkbox"/>	
3.9 ^a	High Efficiency HVAC	0.5 <input type="checkbox"/>	
3.10	High Efficiency HVAC	1.5 <input type="checkbox"/>	
3.11	High Efficiency HVAC	2.5 <input type="checkbox"/>	
4.1	High Efficiency HVAC Distribution System	0 <input type="checkbox"/>	
5.1 ^d	Efficient Water Heating	0.5 <input type="checkbox"/>	
5.2	Efficient Water Heating	0.5 <input type="checkbox"/>	
5.3	Efficient Water Heating	0.5 <input type="checkbox"/>	
5.4	Efficient Water Heating	1.0 <input type="checkbox"/>	
5.5	Efficient Water Heating	1.5 <input type="checkbox"/>	
5.6	Efficient Water Heating	2.5 <input type="checkbox"/>	
5.7	Efficient Water Heating	3.0 <input type="checkbox"/>	
5.8	Efficient Water Heating	TBD <input type="checkbox"/>	
6.1 ^a	Renewable Electric Energy (4.5 credits max)	0.5-4.5 <input type="checkbox"/>	
7.1	Appliance Package	1.5 <input type="checkbox"/>	
		Total Credits	

- a. An alternative heating source sized at a maximum of 0.5 Watts/ft² (equivalent) of heated floor area or 500 Watts, whichever is larger, 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 3.9 can only be taken with Options 3.1 and 3.3. To qualify to claim Option 3.8 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 3.11 may only be taken with Efficient Water Heating Options 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

Simple Heat Load Calculator



Simple Heating System Size: Washington State

This heating system sizing calculator is based on the Prescriptive Requirements of the 2018 Washington State Energy Code (WSEC) and ACCA Manuals J and S. This tool will calculate heating loads only. ACCA procedures for sizing cooling systems should be used to determine cooling loads.

Please complete the green drop-downs and boxes that are applicable to your project. As you make selections in the drop-downs for each section, some values will be calculated for you. If you do not see the selection you need in the drop-down options, please contact the WSU Energy Program at energycode@energy.wsu.edu or (360) 956-2042 for assistance.

Project Information

Contact Information

Heating System Type:

Other Systems Heat Pump

To see detailed instructions for each section, place your cursor on the word "instructions"

Design Temperature

Select closest city

Design Temperature

Design Temperature Difference (ΔT)
 ΔT = Indoor (°F) - Outdoor (Design Temp)

Area of Building

Conditioned Floor Area

Conditioned Floor Area (sq ft)

Average Ceiling Height

Average Ceiling Height (ft)

Conditioned Volume

Glazing and Doors

Select U-Factor

U-Factor X Area = UA

No selection -

Skylights

Select U-Factor

U-Factor X Area = UA

0.50 0.00

Insulation

Attic

Select R-Value

U-Factor X Area = UA

No selection -

Single Rafter or Joist Vaulted Ceilings

Select R-Value

U-Factor X Area = UA

No selection -

Above Grade Walls (see Figure 1)

Select R-Value

U-Factor X Area = UA

No selection -

Floors

Select R-Value

U-Factor X Area = UA

No selection -

Below Grade Walls and Slabs (see Figure 1)

Wall & Slab Select Wall & Slab Insulation

Wall U-Factor X Area = UA

No selection -

Depth Select nearest slab depth

Slab F-Factor X Length = UA

No selection -

Slab on Grade (see Figure 1)

Select R-Value

F-Factor X Length = UA

No selection -

Location of Ducts

Select Location of Ducts

Duct Leakage Coefficient

Sum of UA

Envelope Heat Load _____ Btu / Hour

Sum of UA x ΔT

Air Leakage Heat Load _____ Btu / Hour

Volume x 0.5 ΔT x 0.015

Building Design Heat Load _____ Btu / Hour

Air leakage + envelope heat loss

Building and Duct Heat Load _____ Btu / Hour

Ducts in unconditioned space: sum of building heat loss x 1.10

Ducts in conditioned space: sum of building heat loss x 1

Maximum Heat Equipment Output _____ Btu / Hour

Building and duct heat loss + 40 for forced air furnace

Building and duct heat loss x 1.25 for heat pump



The simple heat load calculator is included in the C3 calculation

Ventilation Requirements

Conditioned Floor Area 2,008 sq. ft.

Number of Bedrooms 3

Run-Time Percent in Each 4-hour Segment 100%

Is the system Balanced? Unbalanced

Is the system Distributed? Not Distributed

Ventilation Code Section IRC, Chapter 15

Whole House Mechanical Ventilation Airflow Rate 83 CFM

HVAC Thermal Distribution System

Download RS-33 (2016) <http://www.energy.wsu.edu/Documents/Duct%20Testing%20RS-33>

Is this a hydronic heating system? No

Location of Ducts Conditioned Space

Location of Air Handler Conditioned Space

Existing Construction: Are Any of These Exceptions True?

Are ducts systems documented to have been previously sealed as confirmed through field verification and diagnostic testing per RS-33? No

Is there less than 40 linear feet in unconditioned spaces? No

Are existing duct systems constructed, insulated or sealed with asbestos? No

Is the project an Addition less than 750 sf of conditioned floor area? No

Is Duct Testing Required? Yes

Maximum Duct Leakage:

Is this a post-construction test? Yes

Maximum total measured duct leakage per square foot 0.08 CFM25 per sq. ft.

Maximum allowable total measured duct leakage 160 CFM25

Option 4.2: A maximum of 10 feet of return ducts and 5 feet of supply ducts are allowed to be located outside of the building thermal envelope, if insulated and sealed per R403.3.7.

Baseline UA Total	425.1	Proposed UA Total	395.1
Proposed Credits	5.0	Proposed Credits	35.0
		UA Process Reduction	9.3%
		UA Reduction	7.7%

If the Proposed UA is the Target UA, and the Proposed Credits from Table 406 are a choice required in Section 406B, then the header notes the WSEC.

Code Compliance Calculator (C3)

Three forms in one and more.

WSU Code Compliance Calculator - WSEC 2018 & 2021
Inputs
Results

Project Information

Contact Information

Messages / Results *

Credit requirements are not met. Select energy credits from Tables 406.2 and 406.3 below

Review required for custom entries - Doors

UA Reduction = 71.3, Proposed UA is better than baseline by 17%:

Whole House Mechanical Ventilation Airflow Rate: 82.5 CFM with Run Time Percent of 100%; Unbalanced, Not Distributed

Maximum allowable total measured duct leakage: 160 CFM25

*Results assume your inputs are complete and correct. Results don't constitute an approval. Analysis should be reviewed by your ARI.

ANALYSIS SET UP

What code compliance pathway are you using? **Table R406.3 UA Trade Off**

Project Building Type? **Addition**

Occupancy Type? **R3 Single family homes and duplexes**

Code Version? **WSEC 2021**

Classification: **Medium Dwelling Unit - 2006 sq. ft.**

Baseline Description: **Code Baseline - Baseline and proposed window areas are equal.**

About Your Selection: **Up to 15 sf exempt window and 24 sf exempt door allowable**

RESULTS - Comparison of Baseline and Proposed Design

Component Performance, R occupancies	Baseline Area		Proposed Design	
	U	UA	U	UA
Doors U =	0.300	43	0.225	43
Overhead Glazing U =	0.500	0	0	0.0
Vertical Glazing U =	0.300	257	0.190	257
Flat/Vaulted Ceilings U =	0.024	2,028	0.017	2,028
Wall (above grade) U =	0.056	1,536	0.041	1,536
Floors over Crawlspace U =	0.029	2,006	0.029	2,006
Slab on Grade F =	0.540	0	0	0.0
Below Grade Wall F =	0.040	800	0.040	800
Below Grade Slab F =	0.560	200	0.560	200

*Values from Table R402.1.2, as of 5/19/2023

Baseline UA Total	426.9	Proposed UA Total	355.6
Required Credits	5.0	Proposed Credits	-3.0
		UA Percent Reduction	16.7%
		UA Reduction	71.3

from Tables 406.2 and 406.3

Maximum Duct Leakage:

Is this a post-construction test? Yes

Maximum total measured duct leakage per square foot 0.08 CFM25 per sq. ft.

Maximum allowable total measured duct leakage 160 CFM25

Option 4.2: A maximum of 10 feet of return ducts and 5 feet of supply ducts are allowed to be located outside of the building thermal envelope, if insulated and sealed per R403.3.7.

WSEC-R Duct Leakage Affidavit

Washington State University Energy Program

Permit: _____ Address or Lot & Block: _____

City: _____ Zip: _____

Card Floor Area (ft²): _____

Single Testing to Meet New Washington State Air Handler in condition: _____

Circle Test Method: _____

Maximum duct leakage Post Construction, by: _____

Post Construction, by: _____

Rough in, total duct leakage Post construction test: _____

Result of test conducted: _____

Duct testing device used: _____

Duct Tester Location: _____

Duct Tester: _____

I certify that these values are correct.

2013 Washington State Energy Code - Residential
Prescriptive Energy Code - Modification to ASHRAE 90.1-2010 Energy Additions in Washington
Single Family - Two & Addition Collection (Oct 1, 2023)

Permit: _____ **Address or Lot & Block:** _____

City: _____ **Zip:** _____

These requirements apply to all the building types, including detached one- and two-family dwellings and multiple single family dwellings (townhouses).

Instructions: This single-family project will use the requirements of the Prescriptive Path below and incorporate the exemptions below listed. Based on the size of the structure, the appropriate number of additional credits are checked as chosen by the permit applicant.

Provide all information from the following tables as building permit drawings: Table R402.1, Insulation and Ventilation Requirements by Component, Table R402.2, Fuel Normalization Credits and R403.1, Energy Credits.

Authorized Representative	Signature	Date
All Climate Zones (Table R402.1.1)		
Penetration of Pallets ^{1,2}	0/0	0/0
Height of Pallets ^{1,2}	0/0	0/0
Ceiling ^{1,2}	0/0	0/0
Wood Frame Wall ^{1,2}	2048 or 13x10	0/0
Floor ^{1,2}	0/0	0/0
Below Grade Wall ^{1,2}	101/100 or 1/8	0/0
Slab On Grade & Pallets ^{1,2}	0/0	0/0

1. Examine the structure, if Pallets and 2048 and 13x10 are measured. When installation is finished in a cavity which lies flat the level or angle indicates the measurement, the corresponding value of the insulation shall be reported. Table R402.1.1 shall not be used for the credit 0/0 or 1/8.

2. The Insulation (R-value) credit includes air gaps.

3. The R-value (R-value) credit is based on the exterior of the wall, or if a continuous insulation on the interior of the wall, or if a 2-inch insulation plus a thermal break between the slab and the basement wall or the exterior of the basement wall. 101/100 or 1/8 shall be reported to the test with 0.5-inch insulation on the exterior of the basement wall plus 0.5-inch insulation on the interior or exterior of the wall. "0/0" means 0 thermal break between floor slab and basement wall.

Duct Testing Affidavit

WSEC-R Duct Leakage Affidavit



WASHINGTON STATE UNIVERSITY
Energy Program

Permit#			
Address or Lot & Block			
City		Zip	

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

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

Post construction test with Ducts inside: (floor area x 0.08) = _____ CFM@25 Pa

Result of test conducted at @ 25 Pa in CFM:

Duct testing device opening setting (circle one if applicable):

Open 1/A 2/B 3/C 4/D 5/E

Duct Tester Location: _____ Pressure Tap Location: _____

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

Testing Company:			
Address			
City		Zip:	

Phone #:		Email:	
----------	--	--------	--

Technician:			
Technician Signature:			
Date of test:		Technicians ID#	

Copy provided to both the AHJ and the owner	Yes	<input type="checkbox"/>	Time and Location stamp of test provided	Yes	<input type="checkbox"/>
	No	<input type="checkbox"/>		No	<input type="checkbox"/>

WSEC-R Code for common Duct testing questions. Not all inclusive...

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 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:

1. Rough-in test: Total leakage shall be less than or equal to 4.0 cfm (113.3 L/min) per 100 square feet (9.29 m²) of conditioned floor area when tested at a pressure differential of 0.1 inches w.g. (25 Pa) across the system, including the manufacturer's air handler enclosure. All registers shall be taped or otherwise sealed during the test. If the air handler is not installed at the time of the test, total leakage shall be less than or equal to 3.0 cfm (85 L/min) per 100 square feet (9.29 m²) of conditioned floor area. 2021 Washington State Energy Code RE-33 *
2. Post construction test: Leakage to outdoors shall be less than or equal to 4 cfm (113.3 L/min) per 100 square feet (9.29 m²) of conditioned floor area or total leakage shall be less than or equal to 4 cfm (113.3 L/min) per 100 square feet (9.29 m²) of conditioned floor area when tested at a pressure differential of 0.1 inches w.g. (25 Pa) across the entire system, including the manufacturer's air handler enclosure. All register boots shall be taped or otherwise sealed during the test.
3. 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.

R502.3.2 Heating and cooling systems. HVAC ducts newly installed as part of an addition shall comply with Section R403.

Exception: The following need not comply with the testing requirements of Section R403.3.3:

1. Additions of less than 150 square feet.
2. Duct systems that are documented to have been previously sealed as confirmed through field verification and diagnostic testing in accordance with procedures in WSU RS-33.
3. Existing duct systems constructed, insulated or sealed with asbestos.

R503.1.2 Heating and cooling systems. New heating, cooling and duct systems that are part of the alteration shall comply with Section R403.

Exceptions:

1. Where ducts from an existing heating and cooling system are extended, duct systems with less than 40 linear feet in unconditioned spaces shall not be required to be tested in accordance with Section R403.2.2.
2. Existing duct systems constructed, insulated or sealed with asbestos.
3. Replacements of space heating equipment shall not be required to comply with Section R403.13 where the rated capacity of the new equipment does not exceed the rated capacity of the existing equipment.



Permit #:	
House address or lot number:	
City, ZIP	
Conditioned floor area (sf):	
Dwelling Unit Enclosure Area:	
Age of house:	
Source (circle one):	Plans Measured

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 1.0 cfm per square foot. Testing shall be conducted with a blower door test at a test pressure of 50 Pa (2.0 inches w.g.). Testing shall be conducted with a blower door test at a test pressure of 50 Pa (2.0 inches w.g.) for existing dwellings.

Volume box needs added

CFM₅₀ = Blower door fan flow at 50 Pascal pressure difference
Volume = Conditioned floor area of the housing unit x ceiling height

SF Blower Door Test Result: _____ ACH₅₀
_____ CFM@50Pa

OR

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.

(Take the CFM and Divide it by the total area of the enclosure area)

MF Blower Door Test Result: _____ CFM@50Pa
_____ CFM/EA (enclosure shell area) SF

Ring (circle one if applicable):	Open A B C
Blower door fan location:	
Weather conditions:	

I certify that these blower door results are accurate and determined using standard industry protocol:

Company name:	
Technician:	
Technician signature:	
Date:	
Phone number:	

R402.4.1.2 Testing. The building or dwelling unit shall be tested for air leakage. Testing shall be conducted in accordance with RESNET/ICC 380, ASTM E779, or ASTM E1827.

Air Barrier Test Affidavit



R402.3.6 Fireplaces. New wood-burning fireplaces shall have tight-fitting flue dampers or doors and outdoor combustion air. When using tight-fitting doors on factory-built fireplaces listed and labeled in accordance with UL 127, the doors shall be tested and listed for the fireplace. When using tight-fitting doors on masonry fireplaces, the doors shall be listed and labeled in accordance with UL 907. Gas fireplaces shall comply with the efficiency requirements in Section R403.7.2.

R402.4 Air leakage. The building thermal envelope shall be constructed to limit air leakage in accordance with the requirements of Sections R402.4.1 through R402.4.5.

R402.4.1 Building thermal envelope air leakage. The building thermal envelope shall comply with Sections R402.4.1.1 through R402.4.1.3. The sealing methods between dissimilar materials shall allow for differential expansion and contraction.

R402.4.1.1 Installation. The components of the building thermal envelope as listed in Table R402.4.1.1 shall be installed in accordance with the manufacturer's instructions and the criteria listed in Table R402.4.1.1, as applicable to the method of construction. Where required by the code official, an approved third party shall inspect all components and verify compliance.

R402.4.1.2 Testing. The building or dwelling unit shall be tested for air leakage. Testing shall be conducted in accordance with RESNET/ICC 380, ASTM E779, or ASTM E1827. Test pressure and leakage rate shall comply with Section

R402.1.3. A written report of the test results, including verified location and time stamp of the date of the test, shall be signed by the testing agency and provided to the building owner and code official. Testing shall be performed at any time after creation of all penetrations of the building thermal envelope. Once visual inspection has confirmed air sealing has been conducted in accordance with Table R402.4.1.1, operable windows and doors manufactured by small business are permitted to be sealed off at the frame prior to the test.

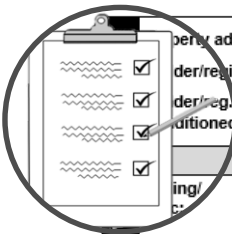
Testing of single-family dwellings and townhouses shall be conducted in accordance with RESNET/ICC 380. Test pressure and leakage rate shall comply with Section R402.1.3.1.

For Group R-2 occupancies, testing shall be conducted in accordance with ASTM E779, ASTM E1827, or ASTM E3158. Test pressure and leakage rate shall comply with Section R402.1.3.2. The individual performing the air leakage test shall be trained and certified by a certification body that is, at the time of permit application, and ISO 17024 accredited certification body including, but not limited to, the Air Barrier Association of America.

During testing:

1. Exterior windows and doors, fireplace and stove doors shall be closed, but not sealed, beyond the intended weatherstripping or other infiltration control measures.
2. Dampers including exhaust, intake, makeup air, as well as backdraft and flue dampers shall be closed, but not sealed beyond intended infiltration control measures.
3. Interior doors, if installed at the time of the test, shall be open, access hatches to conditioned crawl spaces and conditioned attics shall be open.
4. Exterior or interior terminations for continuous ventilation systems and heat recovery ventilators shall be sealed. 2021 Washington State Energy Code RE-27
5. Heating and cooling systems, if installed at the time of the test, shall be turned off.
6. Supply and return registers, if installed at the time of the test, shall be fully open.

Exception: Additions less than 500 square feet of conditioned floor area.



2021 WSEC Residential Energy Compliance Certificate (Effect

Property address: _____
 Designer/registered design professional name: _____
 Designer/registered design pro. signature: _____
 Conditioned floor area: _____ ft² (per building permit)

R-Values (R303.1.1)

Glazing: Vaulted R-_____ Floors: _____ Over unconditioned space R-_____
 Attic R-_____ Slab-on-grade floor R-_____

Walls: Above grade R-_____ Fully insulated slab? Y/N (Circle one)
 Below, int. R-_____ D _____ R-_____, R-_____, R-_____
 Below, ext. R-_____

U-Value of Windows, Skylights and Doors (R303.1.1.3)

Average area weighted U-value from Glazing Worksheet _____

Energy Equalization Credits (Tables R406.2) and Energy Credits (Table R406.3)

System Type Number (1 to 5) _____ (Select one)
 Energy Credits selected (1 to 7) _____
 Energy Equalization Credit _____ + Total Energy Credits _____ = Total Credits _____

Heating, Cooling and Domestic Hot Water		
System	Type (Manufacturer and Model Number)	Efficiency
Heating		
Cooling		
DHW		
Drain water heat recovery		

Onsite Renewable Energy Electric Power System

System type _____ System design capacity _____ kW
 Rated annual generation _____ kWh/yr.

Appliances	Energy Star?
<i>Manufacturer and Model</i>	<i>(Circle one)</i>
Dish washer	Y or N
Refrigerator	Y or N
Washer	Y or N
Dryer	Y or N

Vented or unvented? _____ If vented, CEF rating _____

Gas fireplace / heating stove (Section R402.4.2) Fireplace efficiency (FE) _____
 Heating or Decorative? (Circle one)

Interior + Exterior
R 20 +5

Air Barrier, HVAC Duct, & Ventilation Testing	Circle one
All ductwork and air handler in conditioned space? (See Option 4.2)	Y or N
All ductwork in unconditioned spaces tested at 4% total leakage.	Y or N
All ductwork in unconditioned space tested at 8% total leakage.	Y or N
All ductwork & air handler outside conditioned space insulated to minimum R-8?	Y or N
Air handler present at duct leakage test? (Total leakage 4% if yes, 3% if no)	Y or N
Do HVAC duct leakage tests include GPS and time stamp verification?	Y or N
HVAC system leakage test calculated design target: _____ CFM @ 25 Pa	
HVAC system leakage test measured results: _____ CFM @ 25 Pa	
Building Leakage Testing (R402.4.1.2)	
Dwelling unit leakage test calculated design target: _____ ACH @ 50 Pa	
Dwelling unit leakage test, measured results: _____ ACH @ 50 Pa	
Dwelling unit leakage test (R2 non-corridor only) design target: _____ CFM/sf @ 50 Pa	
Dwelling unit leakage test (R2 non-corridor only) measured: _____ CFM/sf @ 50 Pa	
Dwelling unit leakage tests include GPS and time stamp verification?	Y or N
Whole House Ventilation System Measured Flow Rates (M1505.4 IRC-WA)	
System controls correctly labeled?	Y or N
Whole House Ventilation (WHV) system operation and maintenance (O&M) instructions were provided to the building owner?	Y or N
Provided to: _____ on _____ (date)	
Whole House Ventilation System Type: (Circle one)	
(1) Whole house exhaust fan, location _____	
(2) Balanced HRV/ ERV, location _____	
For R2 low-rise, serves more than one unit?	Y or N
(3) Supply or HRV WHV integral to the air handler. Describe system control sequence of operations or reference to design submittal: _____	
Specify run-time: _____ hours per day _____ CFM	
WHV calculated design minimum flow rate per plan submittal:	
WHV measured min flow rate at commissioning: Exhaust _____ CFM, Supply _____ CFM	
Do WHV flow tests include GPS & time stamp verification?	Y or N
HRV/ERV sensible heat recovery efficiency: _____	
Commissioning Notes:	
All mandatory requirements of WSEC-R have been met?	Y or N

Remodel / Alteration Worksheet

Will you be exposing the walls?

Yes No

If yes,

- 2 X 4 wall studs require R-15 insulation
- 2 X 6 wall studs require R-21 insulation
- If siding is replaced C.I. equal to R-5 will need installed under the siding.

Will the roof/ceiling framing cavities or attic be exposed?

Yes No

If yes,

- Exposed roof or ceiling assemblies must be insulated -
 - Vaulted ceilings, Insulate to the full depth of the framing member
 - Flat ceilings, install R-60 insulation or what the attic space can accommodate based on the roof pitch

Will the floor framing cavities be exposed?

Yes No

If yes,

- Exposed floor cavities must be insulated to R-30

Are the windows and/or doors being replaced?

Yes No

If yes,

- New windows and doors (+frames) must have an area weighted average U-factor of ≤ 0.30

Will the heating or cooling system be replaced?

Yes No

If yes,

- New equipment must meet current requirements and the ducts need to be tested

Will the hot water system be altered?

Yes No

If yes,

- New water heating equipment must meet current code requirements

Are more than 10% of the light fixtures being changed?

Yes No

If yes,

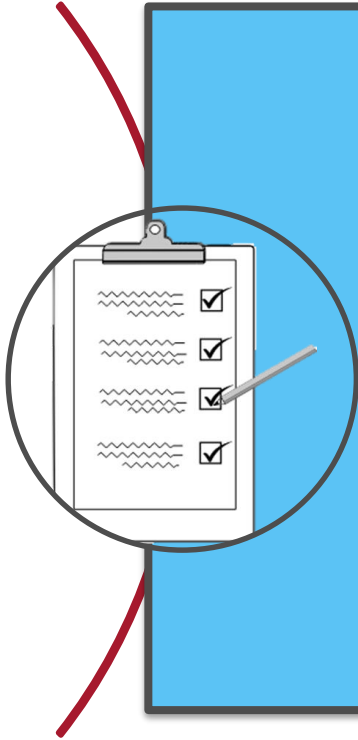
- 100% of all lamps must be high efficacy

Summary of Chapter 5
WSEC – Residential 2021
EPCA Edition:



- ✓ 150 sf exception to R406.2 and R406.3 Credit Selection
 - No duct testing
 - No air barrier test required
- ✓ New language about remodeling and equipment:
 - Additions *shall not create an unsafe or hazardous condition or overload existing building systems.....*
- ✓ **R502.3.1.1 Existing ceilings with attic spaces.** *Where an addition greater than 150 square feet (9.2 m²) adjoins existing ceilings with attic spaces, the existing attic spaces shall comply with Section R402.*
- ✓ **R502.4 Existing plus addition compliance Total Building Performance.**

APPENDIX RA / RB OPTIONAL ENERGY EFFICIENCY MEASURES



Appendix RA—Optional energy efficiency measures—One step.

Building owners may choose to use this appendix to achieve an additional:

6 percent savings in building energy use. The number of additional energy efficiency credits required by Section R406.3 would be increased by the following amounts:

1.0 credit for each new single-family, two-family and townhouse dwelling unit.

0.5 credit for each new dwelling unit within an R-2 occupancy building.

0.5 credit for each addition smaller than 500 square feet to a single-family, two-family or townhouse dwelling unit.

1.0 credit for each addition of 500 square feet or larger to a single-family, two-family or townhouse dwelling unit. Where Section R405,

Simulated performance alternative, is used, the maximum allowable energy consumption shall be **92 percent** of the value calculated according to Section R405.3.

APPENDIX RA / RB OPTIONAL ENERGY EFFICIENCY MEASURES



Appendix RB—Optional energy efficiency measures—Two step.

Building owners may choose to use this appendix to achieve an additional:

12 percent savings in building energy use. The number of additional energy efficiency credits required by Section R406.3 would be increased by the following amounts:

2.0 credit for each new single-family, two-family and townhouse dwelling unit.

1.0 credit for each new dwelling unit within an R-2 occupancy building. 1.0 credit for each addition smaller than 500 square feet to a single-family, two-family or townhouse dwelling unit.

1.5 credit for each addition of 500 square feet or larger to a single-family, two-family or townhouse dwelling unit.

Where Section R405, Simulated performance alternative, is used, the maximum allowable energy consumption shall be 84 percent of the value calculated according to Section R405.3.

Thank you to our sponsor.



Again!

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>)

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