2012 Washington Energy Code - Residential

energycode@energy.wsu.edu
Code Development Process

- **RCW 19.27A.160 Mandates a 70% reduction in energy use by 2031**

- The 2006 Washington State Energy Code (WSEC) is the baseline for the 2031 target.
- Stringency to increase each code cycle which is every 3 years.

- **Mash-up process for 2012 Energy Code**
- The 2012 International Energy Efficiency Code (IECC) and the 2009 WSEC were combined to create the 2012 WSEC.
- In general, the higher stringency requirements of each code was adopted. A big exception is the Blower Door Test Requirement.
- Additional scope beyond the Mash-up was added to achieve the energy reduction required for this code cycle.

- The next slide shows how we are doing …
Incremental Improvement Compared to Targets

### Graph Details

- **Y-axis:** Reduction in Energy Use (2006 Base)

#### Data Points

<table>
<thead>
<tr>
<th>Year</th>
<th>Residential</th>
<th>Commercial</th>
<th>Target: 8.75% Savings</th>
<th>Target: 14% Savings</th>
</tr>
</thead>
<tbody>
<tr>
<td>2006</td>
<td>100%</td>
<td>100%</td>
<td>100%</td>
<td>100%</td>
</tr>
<tr>
<td>2009</td>
<td>82.7%</td>
<td>86.8%</td>
<td>91%</td>
<td>85%</td>
</tr>
<tr>
<td>2012</td>
<td>76.1%</td>
<td>82.0%</td>
<td>83%</td>
<td>74%</td>
</tr>
<tr>
<td>2015</td>
<td>65%</td>
<td>56%</td>
<td>74%</td>
<td>64%</td>
</tr>
<tr>
<td>2018</td>
<td>56%</td>
<td>48%</td>
<td>65%</td>
<td>55%</td>
</tr>
<tr>
<td>2021</td>
<td>48%</td>
<td>39%</td>
<td>56%</td>
<td>47%</td>
</tr>
<tr>
<td>2024</td>
<td>39%</td>
<td>35%</td>
<td>48%</td>
<td>41%</td>
</tr>
<tr>
<td>2027</td>
<td>35%</td>
<td>30%</td>
<td>39%</td>
<td>35%</td>
</tr>
<tr>
<td>2030</td>
<td>30%</td>
<td>30%</td>
<td>35%</td>
<td>30%</td>
</tr>
</tbody>
</table>
Residential Building

For this code, includes detached one and two-family dwellings and multiple single-family dwellings (townhouses) as well as Group R-2, and R-3 buildings three stories or less in height above grade plane.
Scope

2012 Residential Energy Code Chapters R1 thru R4

IRC Buildings
1. Single family
2. Duplexes
3. Townhouses

AND

IBC Buildings three stories or less in height
4. R-2 occupancies- Apartments, and non-transient boarding, hotel, motels, and congregate residences.
5. R-3 occupancies- Residential occupancies where the occupants are primarily permanent and not classified as Group R-1, R-2, I occupancies or Washington State licensed care facilities. Examples: Bed & Breakfast and boarding houses (transient) with 10 or fewer occupants.


The code is a maximum and minimum energy code requirements for each town, city and county within the State of Washington.
R101.4.3 Additions, Alterations, Renovations or Repairs

Shall require building systems or portions thereof to conform to current code provisions without requiring unaltered portion(s) to comply.

Exceptions:
- Existing 2x4 walls filled full depth where exposed with R-15.
- 2x6 walls insulated to R-21.
- Less than 60 percent of luminaires are replaced that do not increase lighting power.

Building official may approve designs or alterations or repairs which do not fully comply provided:

1. The alteration or repair improves the energy efficiency of the building.
   or
2. The alteration or repair is energy efficient and is necessary for health, safety, and welfare of the general public.
R101.4.3.1 Mechanical Systems

When a space conditioning system is altered by the installation or replacement of space conditioning equipment the duct systems shall be tested.

The test results shall be provided to the owner and building official.

No real change from past WSEC language

Duct Leakage Test Result forms are available on the WSU Extension Energy Program website:

http://www.energy.wsu.edu/Documents/Duct%20Leakage%20affidavit%20existing%201_29_12.pdf

Duct Leakage Test Results (Existing Construction)

Permit #: __________________________

House address or lot number: ____________________________

City: ________________ Zip: ________________

Cond. Floor Area (ft²): ________________

☐ Duct tightness testing is not required for this residence per exceptions listed at the end of this document

Test Result: ________________ CFM@25Pa

Ring (circle one): Open 1 2 3

Duct Tester Location: ____________________________

Pressure Tap Location: ____________________________

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

Company Name: ____________________________

Duct Testing Technician: ____________________________

Technician Signature: ____________________________ Date: ________________

Phone Number: ____________________________

Washington State Energy Code Reference:

R101.4.3.1 Mechanical Systems: When a space-conditioning system is altered by the installation or replacement of space-conditioning equipment (including replacement of the air handler, outdoor condensing unit of a split system air conditioner or heat pump, cooling or heating coil, or the furnace heat exchanger), the duct system that is connected to the new or replacement space-conditioning equipment shall be tested as specified in RS-33. The test results shall be provided to the building official and the homeowner.

Exceptions:
1. Duct systems that are documented to have been previously sealed as confirmed through field verification and diagnostic testing in accordance with procedures in RS-33.
2. Ducts with less than 60 linear feet in unconditioned spaces.
3. Existing duct systems constructed, insulated or sealed with asbestos.
4. Additions of less than 750 square feet.
Duct Leakage Affidavit (New Construction)

 Permit #: __________________________

 House address or lot number: ________________________________

 City: _________________________ Zip: _________________________

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

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

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

 Circle Test Method: Leakage to Outside Total Leakage

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

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

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

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

 Test Result: ________ CFM@25Pa

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

 Duct Tester Location: __________________________ Pressure Tap Location: ________________

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

 Company Name: ___________________________ Technician: ___________________________

 Technician Signature: ___________________________

 Date: ___________________________

 Phone Number: ___________________________
R101.4.4 Change of Use or Occupancy

Change of use or occupancy shall be brought into full compliance with the 2012 WSEC.
Wall insulation shall be inspected after all insulation, air barrier, and vapor retarder* materials are in place and before wall covering is placed.

Insulation must be installed to the manufactures specifications. There should be no gaps, voids, miss alignment or compression. Insulation must be in full contact with the air barrier to complete the Thermal Barrier.

*More on vapor retarders later
R110 Violations

It shall be unlawful for **any** person, firm, or corporation to erect or construct any building, or remodel or rehabilitate **any** existing building or structure in the state, or allow the same to be done, contrary to or in violation of **any** of the provisions of the code.
R202 Definition

**Building:**
Any structure used or intended for supporting or sheltering any use or occupancy, including any mechanical systems, service water, heating systems, and electrical power and lighting systems located on the building site and supporting the building.

**High-Efficacy Lamps.** Compact fluorescent lamps, T-8 or smaller diameter linear fluorescent lamps, or lamps with a minimum efficacy of:
1. 60 lumens per watt for lamps over 40 watts;
2. 50 lumens per watt for lamps over 15 watts to 40 watts; and
3. 40 lumens per watt for lamps 15 watts or less.
R301.1 Climate Zone; Clark County

Clark county climate zones changes from Zone I to now Marine 4C

<table>
<thead>
<tr>
<th>Key: A. Moist, B. Dry, C. Marine</th>
</tr>
</thead>
<tbody>
<tr>
<td>Absence of moisture designation indicates moisture regime is irrelevant.</td>
</tr>
</tbody>
</table>

**WASHINGTON**

- 5B Adams
- 5B Asotin
- 5B Benton
- 5B Chelan
- 4C Chelan
- 4C Clark
- 5B Columbia
- 4C Cowlitz
- 5B Douglas
- 6B Ferry
- 5B Franklin
- 5B Garfield
- 5B Grant
- 4C Grays Harbor
- 4C Island
- 4C Jefferson
- 4C King
- 4C Kitsap
- 5B Kittitas
- 5B Klickitat
- 4C Lewis
- 5B Lincoln
- 4C Mason
- 6B Okanogan
- 4C Pacific
- 6B Pend Oreille
- 4C Pierce
- 4C San Juan
- 4C Skagit
- 5B Skamania
- 4C Snohomish
- 5B Spokane
- 6B Stevens
- 4C Thurston
- 4C Wahkiakum
- 5B Walla Walla
- 4C Whatcom
- 5B Whitman
- 5B Yakima
R303.1.1 Building thermal envelope insulation

An R-value mark shall be applied to each piece of building thermal insulation 12-inches or greater in width.

Installers shall provide a certification listing for the following;
- Type
- Manufacturer
- R-value of insulation installed in each element of envelope

For blown or sprayed insulation the following shall be provided:
installed thickness, settled thickness, settled R-value, installed density, coverage area and number of bags.

For foam insulation the following shall be provided:
installed thickness and R-value at the installed thickness

The installer shall sign, date and post certification in a conspicuous location on site.
R401.3 Energy Compliance Certificate (Mandatory)

A permanent certificate shall be completed and posted on or within three feet of the electrical panel.

The mandatory certificate shall be filled out by the builder or design professional.

The placement of the required certificate shall not obstruct or cover electrical labels.

Forms are available on the WSU Extension Energy Program website:
http://www.energy.wsu.edu/Documents/WSEC-2012-Avery-6573_2_Per_Sheet.pdf
Property Address: 

Conditioned Floor Area: ____________ Date: __/__/____

Builder or registered design professional: 

__________________________

Signature: 

<table>
<thead>
<tr>
<th>R-Values</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ceiling:</td>
</tr>
<tr>
<td>Vaulted R- [ ]</td>
</tr>
<tr>
<td>Floors:</td>
</tr>
<tr>
<td>Over unconditioned space R- [ ]</td>
</tr>
<tr>
<td>Attic R- [ ]</td>
</tr>
<tr>
<td>Slab on grade floor R- [ ]</td>
</tr>
<tr>
<td>Walls:</td>
</tr>
<tr>
<td>Above grade R- [ ]</td>
</tr>
<tr>
<td>Doors:</td>
</tr>
<tr>
<td>R- [ ]</td>
</tr>
<tr>
<td>Below, int. R- [ ]</td>
</tr>
<tr>
<td>R- [ ]</td>
</tr>
<tr>
<td>Below, ext. R- [ ]</td>
</tr>
<tr>
<td>R- [ ]</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>U-Factors and SHGC</th>
</tr>
</thead>
<tbody>
<tr>
<td>NFRC rating (or)</td>
</tr>
<tr>
<td>Windows U- [ ]</td>
</tr>
<tr>
<td>SHGC- [ ] N/A</td>
</tr>
<tr>
<td>Default rating (Appendix A WSEC 2012)</td>
</tr>
<tr>
<td>Skylights U- [ ]</td>
</tr>
<tr>
<td>SHGC- [ ] N/A</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Table 406.2 Option(s)</th>
<th>Total 406.2 Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heating, Cooling &amp; Domestic Hot Water</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>System</th>
<th>Type</th>
<th>Efficiency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heating</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cooling</td>
<td></td>
<td></td>
</tr>
<tr>
<td>DHW</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Duct &amp; Building Air Leakage</th>
</tr>
</thead>
<tbody>
<tr>
<td>All ducts &amp; HVAC in conditioned space (yes / no) Insulation R- [ ]</td>
</tr>
<tr>
<td>Air handler present (yes / no)</td>
</tr>
<tr>
<td>Test Target ______ CFM@25Pa Test Result ______ CFM@25Pa</td>
</tr>
<tr>
<td>Building air leakage target: ACH50 &lt; 5.0 - Tested leakage: ACH50 = [ ]</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Onsite Renewable Energy Electric Power System</th>
</tr>
</thead>
<tbody>
<tr>
<td>System type: [ ] Rated annual generation [ ] Kwh</td>
</tr>
</tbody>
</table>
**R402.1.1 General Prescriptive**

<table>
<thead>
<tr>
<th>Climate Zone</th>
<th>5 and Marine 4</th>
<th>6</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fenestration U-factor&lt;sup&gt;b&lt;/sup&gt;</td>
<td>0.30</td>
<td>0.30</td>
</tr>
<tr>
<td>Skylight&lt;sup&gt;b&lt;/sup&gt; U-factor</td>
<td>0.50</td>
<td>0.50</td>
</tr>
<tr>
<td>Glazed Fenestration SHGC&lt;sup&gt;b, e&lt;/sup&gt;</td>
<td>NR</td>
<td>NR</td>
</tr>
<tr>
<td>Ceiling R-Value&lt;sup&gt;k&lt;/sup&gt;</td>
<td>49</td>
<td>49</td>
</tr>
<tr>
<td>Wood Frame Wall&lt;sup&gt;g, m-n&lt;/sup&gt; R-Value</td>
<td>21 int</td>
<td>21+5ci</td>
</tr>
<tr>
<td>Mass Wall R-Value&lt;sup&gt;i&lt;/sup&gt;</td>
<td>21/21&lt;sup&gt;h&lt;/sup&gt;</td>
<td>21+5&lt;sup&gt;h&lt;/sup&gt;</td>
</tr>
<tr>
<td>Floor R-Value</td>
<td>30&lt;sup&gt;g&lt;/sup&gt;</td>
<td>30&lt;sup&gt;g&lt;/sup&gt;</td>
</tr>
<tr>
<td>Below-Grade&lt;sup&gt;c, m&lt;/sup&gt; Wall R-Value</td>
<td>10/15/21 int + TB</td>
<td>10/15/21 int + TB</td>
</tr>
<tr>
<td>Slab&lt;sup&gt;d&lt;/sup&gt; R-Value &amp; Depth</td>
<td>10, 2 ft</td>
<td>10, 4 ft</td>
</tr>
</tbody>
</table>

Footnote k: single rafter vault ceilings may use R38
R-38 shall be deemed to satisfy the requirement of R-49 wherever the full height of the uncompressed R-38 insulation extends over the wall top plate at the eaves.
R402.2.1.1 Loose insulation in attic spaces

Blown or poured loose fill insulation may be used in attic spaces with interior slopes is less than 3:12 and there is at least 30-inches of clear distance from top of the bottom chord or ceiling joist to the underside of sheathing.
R303.1.1.1 Insulation Markers
The thickness of blown-in or sprayed roof/ceiling insulation (fiberglass or cellulose) shall be written in inches (mm) on markers that are installed at least one for every 300 square feet (28 m²) throughout the attic space.

R303.1.3 Insulation Markers
Insulation marker installed in attic. Make sure the marker is applicable to the type of insulation installed (fiberglass, cellulose, etc.).
Floor insulation shall be installed to maintain permanent contact with underside of subfloor.
Floor insulation shall have supports installed so that spacing is not more than 24-inches on center. The foundation vents shall be installed with the top of vent below the lower level surfaces of the insulation.
Figure 1-3

Post and Beam Insulation Supports

1/2" chipboard underlay over vapor retarder

2x floor decking on 4 x 6 beams at 48" or 32" O.C.
Lath insulation supports at 24" O.C.
Continuous nailer at each row of posts
Pressure treated nailer secured to foundation

Unfaced insulation
Locate foundation vents below insulation or baffle

6 mil polyethylene moisture barrier
R402.2.7 Floors

Exception:
1) A baffle shall be installed where the top of the vent is not below the lower surface of the floor insulation.

![Diagram showing floor vent installation with a baffle]
R402.2.7 Floors

Exception:
2) Substantial contact with the surface being insulated is not required in enclosed floor/ceiling assemblies containing ducts where full depth of insulation is installed between the duct and the exterior surface.
26 gauge galvanized flashing or approved equal

grade surface water away from foundation at least 6" within the first 10'-0" or slope to drain or swale R401.3

Option 1: R-10 perimeter insulation

Option 2: max. 2x2 p.t nailer strip permitted w/R-10 rigid insulation - 24" total length.

3 1/2" monolithic concrete slab

heated space

pressure treated plate w/ 1/2" dia. x 10" anchor bolts @ 6'-0" o.c. and maximum 12" from ends and splices w/nut and 3"x3"x1/2" plate washers-typical sill seal if heated

one #5 or two #4's located in middle third of the footing - min. 30" lap-grade 60 steel required. Secure tie wire R403.1.2

12" single story
15" two story
23" three story
Table R403.1
Table R402.1.1 footnote c;

“10/15/21+TB” allows several options for meeting below grade wall insulation requirements:

R-10 rigid (continuous) on exterior of below grade wall.

OR

R-15 rigid (continuous) on interior of below grade wall and R-5 thermal break between slab and wall.

OR

R-21 cavity insulation on interior of below grade wall and R-5 thermal break between the slab and wall.

OR

R-13 cavity insulation on interior of wall plus R-5 rigid (continuous) on interior of wall and R-5 thermal break between slab and wall.
R402.2.8 Basement walls

Exterior insulation from top of footing to top of below grade wall and shall be approved for below grade use.

Above grade insulation shall be protected.

Interior insulation shall be from the top of the wall to the floor.

Shall include R-5 thermal break between the slab and the wall.
R-10 continuous insulation (ci) @ exterior

R-15 continuous insulation @ interior with R-5 thermal break

Below grade wall R-values per Table R402.1.1. Insulation and fenestration requirements by component
R-21 cavity insulation with R-5 thermal break

R-13 cavity insulation with R-5 continuous (ci)

BELOW GRADE WALL R-VALUES PER TABLE R402.1.1
INSULATION AND FENESTRATION REQUIREMENTS BY COMPONENT
R402.2.8 Basement walls

R-21 walls with thermal break

(Notice no vapor barrier)
R702.7 Vapor Retarders, IRC

Required on above grade walls

Not required on basement walls and below grade portion of any wall
Vapor Retarder

VAPOR RETARDER CLASS. A measure of the ability of a material or assembly to limit the amount of moisture that passes through that material or assembly. Vapor retarder class shall be defined using the desiccant method with Procedure A of ASTM E 96 as follows:

- Class I: 0.1 perm or less
- Class II: 0.1 < perm ≤ 1.0 perm
- Class III: 1.0 < perm ≤ 10 perm

R702.7.2 Material vapor retarder class. The vapor retarder class shall be based on the manufacturer’s certified testing or a tested assembly.

The following shall be deemed to meet the class specified:

- Class I: Sheet polyethylene, unperforated aluminum foil.
- Class II: Kraft-faced fiberglass batts.
- Class III: Latex or enamel paint.

Vapor retarder requirements now in IRC
IRC-R702.7 Vapor Retarders

Class I or II vapor retarders are required on the interior side of framed walls in Climate Zones Marine 4 C and 5.

Exceptions:
1. Basement walls
2. Below grade portion of any wall

Note
A Vapor Retarder Primer that has a 1 perm rating or less meets the Class II requirement. A completed and signed Vapor Retarder Product Information Sheet is required for this option.
VAPOR RETARDER PRODUCT INFORMATION SHEET

Contractor name & phone number

☐ Class I
  ☐ Sheet polyethylene
  ☐ Unperforated aluminum

☐ Class II
  ☐ Kraft-faced fiberglass batts
  ☐ Vapor retarder primer

*Fill out the box below if using Vapor Retarder Primer ~ Product Data Cut sheet must be attached*

Product Brand: _______________________________

Product Number & Name: _______________________________

Product Description: ___________________________________

VOC: _______________________________

Perm Rating: _______________________________

Required Film Thickness: (Dry Mil) _________ (Wet Mil) _________

Square Feet Effected: ___________ Gallons Used: ___________

Wet Film Thickness measured: _______________________________

Signature: _______________________________

Date: _______________________________

By signing this, I am verifying that all information listed above is true and accurate to the best of my knowledge.

Permit Number ___________/ ___________

Site Address _______________________________
R402.4 Air Leakage (Mandatory)

The building thermal envelope shall be constructed to limit air leakage.

**Building Thermal Envelope:**
The *below-grade walls, above-grade walls, floor, roof* and any other building elements that enclose *conditioned space* or provides a boundary between *conditioned space* and exempt or unconditioned space.
R402.4.1.2
The building or dwelling unit shall be tested and verified as having an air leakage rate of not exceeding 5 air changes per hour (5 ACH at 50 pa)

R402.4.2
New wood burning fireplaces shall have tight-fitting flue dampers and outdoor combustion air.

R402.4.4
Recessed luminaires installed within thermal envelope shall be IC rated type and certified under ASTM E283 as having an air leakage rate of not more than 2.0 cfm when tested at 75 pa. All recessed lights shall be sealed with gaskets or caulk between the housing and the interior wall or ceiling covering.
R402.4.1.2 Air Leakage Testing

Blower door testing required for all new construction and additions.

Results shall be reported on Certificate.

Test shall not exceed a maximum leakage rate of **5.0 ACH at 50 pa**

**Note**
For Energy Credit option 2a the rate is **4.0 ACH at 50 pa**

For Energy Credit Option 2b the rate is **2.0 ACH at 50 pa**

For Energy Credit Option 2c the rate is **1.5 ACH at 50 pa**
Air barrier and thermal barrier
• Continuous air barrier shall be installed
• Thermal envelope shall contain an air barrier
• Breaks or joints shall be sealed
• Air – permeable insulation shall not be used as sealing material

Cavity insulation
• All cavities in thermal envelope shall be filled
• Batt type insulation shall have no voids, gaps or misalignment
• Faced batt insulation shall be stapled to stud face
• There shall be no compression
Ceiling/attic
- All types of attic access shall be sealed
- Batt insulation may be compressed at exterior wall line for venting

Walls
- Corners and headers shall be insulated
- Junction of top plate and top of exterior walls shall be sealed
- Knee walls shall be sealed
- Exterior thermal envelope insulation shall be in substantial contact and continuous alignment with the air barrier

Windows, skylights, and doors
- Shall be sealed at jambs and framing
Seal

Walls – interior rigid foam, air – vapor barrier
Joints taped/sealed with gasket or caulk at locations such as:
- top of wall
- window rough opening
- electrical boxes
- bottom of wall
Table 402.1.1 Footnote “k” Intermediate Framing

“INT” walls require R-10 insulated headers. These drawings show various ways to achieve this requirement.
Table R402.4.1.1 Air Barrier and insulation installation (cont’d)

**Rim joists**
- Shall be insulated and include the air barrier

**Floors above garages**
- Insulation installed in substantial contact with subfloor underside

**Garage separation**
- Air sealing between garage and conditioned spaces

**Recessed lighting**
- Installed in thermal envelope shall be IC rated, air tight, and sealed
Type IC rated fixture, certified tested 2.0 CFM maximum air movement

Gasket between fixture and gypsum board or sealant around opening.
Table R402.4.1.1 Air Barrier and insulation installation (cont’d)

**Plumbing and Wiring**
- Batt insulation shall be cut to fit tight in exterior walls with no compression, voids or gaps
- Shall extend behind piping and wiring

**Showers and Tubs**
- Exterior walls adjacent to showers and tubs shall be insulated and the air barrier shall be installed separating them from the shower or tub

**Electrical and phone box**
- Air barrier shall be installed behind boxes and sealed

**HVAC register boots**
- Sealed at subfloor or drywall penetrations
Figure 5-4

Gasket at Tub Penetration

Generally, tub drain and overflow pipes require large penetration in sub-floor.

- Staple gasket to sub-floor
- Gasket (Covers entire drain penetration in floor)
- Seal penetrations in gasket
Figure 5-1
Critical Areas for Air leakage Control

**Positive Pressure:**
Moist indoor air leaks into cavities (potential moisture problem).

**Negative Pressure (Exhaust Ventilation):**
Dry outdoor air leaking in prevents moist indoor air from leaking out (prevents moisture problems).
IRC Section AF101 General

Unvented crawl spaces and closable vents are not permitted in any high radon potential county.

EPA MAP OF RADON ZONES

High Radon Counties in Washington: Clark, Ferry, Okanogan, Pend Oreille, Skamania, Spokane and Stevens
R403.2.1 Duct insulation

Ducts shall be insulated to R-8 minimum

Exception:
Ducts within thermal envelope.

Crawl space ducts do not qualify for the exemption and must be insulated
R403.2.2 Sealing (Mandatory)

Ducts, air handlers, and filter boxes shall be sealed.

Exception:
- Spray foam
- Inaccessible duct connections where attached with screws
- Continuously welded and locking type joints and seams with less than 2-inch water column pressures

Seal over flex to pipe, not between
R403.2.2 Sealing / Testing

Ducts shall be leak tested

Duct tightness shall be verified by either of the following:

1. Post-construction testing
2. Rough-in testing

Either test shall be less than or equal to 4 cfm per 100 sq ft of conditioned floor area tested at 0.1 inches w.g. (25 pa) across the entire system.

Exception:
Where all ducts are within thermal envelope.

Crawl space ducts do not qualify for this exemption.
R403.2.3 Building Cavities (Mandatory)

Building cavities shall not be used for ducts or plenums.

Ducts in exterior walls, floors or ceilings shall not displace envelope insulation.
R403.4.2 Hot water piping insulation

Insulation for hot water pipes shall be a minimum thermal resistance of R-3 (changed from R-4 by emergency rule 13-23-095)

This requirement is for ALL hot water lines throughout, not just in unconditioned locations.
R403.4.3 Electric water heaters

All electric water heater in unheated spaces or on concrete floors shall be placed on non-compressible R-10 pads.
R403.6 Equipment Sizing (Mandatory)

Heating and cooling equipment shall be sized in accordance with ACCA Manual S based on building loads calculated in accordance with ACCA Manual J or other approved heating and cooling calculation methodologies.

You want, how many BTU’s?
M1601.1 Duct Design

Duct systems serving heating, cooling and ventilation equipment shall be installed per IRC and ACCA Manual D or other approved method.

All ducting shall be sized to adequately provide required air within building without incorrectly up sizing HVAC and violating code.
R404.1 Lighting (Mandatory)

A minimum of 75% of permanent installed Lamps shall be high-efficacy.
R406.2 Additional Energy Efficiency requirements (Mandatory)

Each dwelling unit and townhouses shall comply with sufficient options from Table R406.2

The minimum credit requirements are as follows:

1. Small dwelling unit less than 1500 sq ft . .........................0.5 points
2. Medium dwelling units not included in #1 or #3 ...............1.5 points
3. Large dwelling units exceeding 5,000 sq ft . ..................... 2.5 points
## TABLE 406.2
ENERGY CREDITS (DEBITS)

<table>
<thead>
<tr>
<th>OPTION</th>
<th>DESCRIPTION</th>
<th>CREDIT(S)</th>
</tr>
</thead>
</table>
| la     | EFFICIENT BUILDING ENVELOPE 1a:  
Prescriptive compliance is based on Table R402.1.1 with the following modifications:  
Fenestration U = 0.28  
Floor R-38  
Slab on grade R-10 perimeter and under entire slab  
Below grade slab R-10 perimeter and under entire slab  
or  
Compliance based on Section R402.1.4: Reduce the Total UA by 5%. | 0.5 |
| lb     | EFFICIENT BUILDING ENVELOPE 1b:  
Prescriptive compliance is based on Table R402.1.1 with the following modifications:  
Fenestration U = 0.25  
Wall R-21 plus R-4  
Floor R-38  
Basement wall R-21 int plus R-5 ci  
Slab on grade R-10 perimeter and under entire slab  
Below grade slab R-10 perimeter and under entire slab  
or  
Compliance based on Section R402.1.4: Reduce the Total UA by 15%. | 1.0 |
| lc     | EFFICIENT BUILDING ENVELOPE 1c:  
Prescriptive compliance is based on Table R402.1.1 with the following modifications:  
Fenestration U = 0.22  
Ceiling and single-rafter or joist-vaulted R-49 advanced  
Wood frame wall R-21 int plus R-12 ci  
Floor R-38  
Basement wall R-21 int plus R-12 ci  
Slab on grade R-10 perimeter and under entire slab  
Below grade slab R-10 perimeter and under entire slab  
or  
Compliance based on Section R402.1.4: Reduce the Total UA by 30%. | 2.0 |
| 2a     | AIR LEAKAGE CONTROL AND EFFICIENT VENTILATION 2a:  
Compliance based on R402.4.1.2: Reduce the tested air leakage to 4.0 air changes per hour maximum  
and  
All whole house ventilation requirements as determined by Section M1507.3 of the  
*International Residential Code* shall be met with a high efficiency fan (maximum 0.35  
watts/cfm), not interlocked with the furnace fan ventilation systems using a furnace  
including an ECM motor are allowed, provided that they are controlled to operate at  
low speed in ventilation only mode.  
To qualify to claim this credit, the building permit drawings shall specify the option  
being selected and shall specify the option being selected and shall specify the  
maximum tested building air leakage and shall show the heat recovery ventilation  
system. | 0.5 |
<table>
<thead>
<tr>
<th></th>
<th>AIR LEAKAGE CONTROL AND EFFICIENT VENTILATION</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>2b</td>
<td>Compliance based on Section R402.4.1.2: Reduce the tested air leakage to 2.0 air changes per hour maximum and All whole house ventilation requirements as determined by Section M1507.3 of the <em>International Residential Code</em> shall be met with a heat recovery ventilation system with minimum sensible heat recovery efficiency of 0.70. 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.</td>
<td>1.0</td>
<td></td>
</tr>
<tr>
<td>2c</td>
<td>Compliance based on Section R402.4.1.2: Reduce the tested air leakage to 1.5 air changes per hour maximum and All whole house ventilation requirements as determined by Section M1507.3 of the <em>International Residential Code</em> shall be met with a heat recovery ventilation system with minimum sensible heat recovery efficiency of 0.85. 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.</td>
<td>1.5</td>
<td></td>
</tr>
<tr>
<td>3a</td>
<td>HIGH EFFICIENCY HVAC EQUIPMENT</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3a</td>
<td>Gas, propane or oil-fired furnace with minimum AFUE of 95% 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.</td>
<td>0.5</td>
<td></td>
</tr>
<tr>
<td>3b</td>
<td>Air-source heat pump with minimum HSPF of 8.5 To qualify to claim this credit, the building permit drawings shall specify the option being selected and shall specify the heating equipment type and the minimum equipment efficiency.</td>
<td>1.0</td>
<td></td>
</tr>
<tr>
<td>3c</td>
<td>Closed-loop ground source heat pump, with a minimum COP of 3.3 or Open loop water source heat pump with a maximum pumping hydraulic head of 150 feet and minimum COP of 3.6 To qualify to claim this credit, the building permit drawings shall specify the option being selected and shall specify the heating equipment type and the minimum equipment efficiency.</td>
<td>2.0</td>
<td></td>
</tr>
<tr>
<td>3d</td>
<td>DUCTLESS SPLIT SYSTEM HEAT PUMPS, ZONAL CONTROL: In homes where the primary space heating system is zonal electric heating, a ductless heat pump system shall be installed and provide heating to at least one zone of the housing unit. To qualify to claim this credit, the building permit drawings shall specify the option being selected and shall specify the heating equipment type and the minimum equipment efficiency.</td>
<td>1.0</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>HIGH EFFICIENCY HVAC DISTRIBUTION SYSTEM:* All heating and cooling system components installed inside the conditioned space. All combustion equipment shall be direct vent or sealed combustion. Locating system components in conditioned crawl spaces is not permitted under this option. Electric resistance heat is not permitted under this option. Direct combustion heating equipment with AFUE less than 80% is not permitted under this option. To qualify to claim this credit, the building permit drawings shall specify the option being selected and shall specify the heating equipment type and shall show the location of the heating and cooling equipment and all the ductwork.</td>
<td>1.0</td>
<td></td>
</tr>
</tbody>
</table>
5a **EFFICIENT WATER HEATING 5a:**
Water heating system shall include one of the following:
- Gas, propane or oil water heater with a minimum EF of 0.62
- Electric water heater with a minimum EF of 0.93

*and for both cases:*
All showerhead and kitchen sink faucets installed in the house shall be rated at 1.75 GPM or less. All other lavatory faucets shall be rated at 1.0 GPM or less.\(^b\)

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 shall specify the maximum flow rates for all showerheads, kitchen sink faucets, and other lavatory faucets.

5b **EFFICIENT WATER HEATING 5b:**
Water heating system shall include one of the following:
- Gas, propane or oil water heater with a minimum EF of 0.82
- 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
- Electric heat pump water heater with a minimum EF of 2.0 and meeting the standards of NEEA’s Northern Climate Specifications for Heat Pump Water Heaters
- Water heater heated by ground source heat pump meeting the requirements of Option 3c.

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.

6 **RENEWABLE ELECTRIC ENERGY:**
For each 1200 kWh of electrical generation provided annually by on-site wind or solar equipment 0.5 credit shall be allowed, up to 3 credits. Generation shall be calculated as follows:
- For solar electric systems, the design shall be demonstrated to meet this requirement using the National Renewable Energy Laboratory calculator P/VWATTS.
- 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 production.

---

**a. Interior Duct Placement.** Ducts included as Option 4 of Table R406.2 shall be placed wholly within the heated envelope of the housing unit. The placement shall be inspected and certified to receive the credits associated with this option.

**Exception:** Ducts complying with this section may have up to 5% of the total linear feet of ducts located in the exterior cavities or buffer spaces of the dwelling. If this exception is used the ducts will be tested to the following standards:
- Post-construction test: Leakage to outdoors shall be less than or equal to 1 CFM per 100 ft\(^2\) 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.

**b. Plumbing Fixtures Flow Ratings.** Low flow plumbing fixtures (water closets and urinals) and fittings (faucets and showerheads) shall comply with the following requirements:
1. Residential bathroom lavatory sink faucets: Maximum flow rate - 3.8 L/min (1.0 gal/min) when tested in accordance with ASME A112.18.1/CSA B125.1.
2. Residential kitchen faucets: Maximum flow rate - 6.6 L/min (1.75 gal/min) when tested in accordance with ASME A112.18.1/CSA B125.1.
3. Residential showerheads: Maximum flow rate - 6.6 L/min (1.75 gal/min) when tested in accordance with ASME A112.18.1/CSA B125.1.
Prescriptive Energy Code Compliance for Climate Zones 6, 5 and Marine 4

This project will use the requirements of the Prescriptive Path below and incorporate the the minimum values listed. In addition, based on the size of the structure, the appropriate number of additional credits are checked as chosen by the permit applicant.

<table>
<thead>
<tr>
<th>Climate Zone</th>
<th>5 &amp; Marine 4</th>
<th>6</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>R-Value³</td>
<td>U-Factor³</td>
</tr>
<tr>
<td>Fenestration U-Factor b</td>
<td>n/a</td>
<td>0.30</td>
</tr>
<tr>
<td>Skylight U-Factor</td>
<td>n/a</td>
<td>0.50</td>
</tr>
<tr>
<td>Glazed Fenestration SHGC</td>
<td>n/a</td>
<td>n/a</td>
</tr>
<tr>
<td>Ceiling</td>
<td>40⁰</td>
<td>0.026</td>
</tr>
<tr>
<td>Wood Frame Wall</td>
<td>21 int</td>
<td>0.056</td>
</tr>
<tr>
<td>Mass Wall R-Value</td>
<td>21/21⁰</td>
<td>0.050</td>
</tr>
<tr>
<td>Floor</td>
<td>30⁰</td>
<td>0.029</td>
</tr>
<tr>
<td>Below Grade Wall k</td>
<td>10/15/21 int + TB</td>
<td>0.042</td>
</tr>
</tbody>
</table>

*Table R402.1.1 and Table R402.1.3 Footnotes included on Page 2.

Each dwelling unit in one and two-family dwellings and townhouses, as defined in Section 101.2 of the International Residential Code shall comply with sufficient options from Table R406.2 so as to achieve the following minimum number of credits:

- 1. Small Dwelling Unit: 0.5 points
  - Dwelling units less than 1500 square feet in conditioned floor area with less than 300 square feet of fenestration area. Additions to existing building that are less than 750 square feet of heated floor area.

- 2. Medium Dwelling Unit: 1.5 points
  - All dwelling units that are not included in #1 or #3, including additions over 750 square feet.

- 3. Large Dwelling Unit: 2.5 points
  - Dwelling units exceeding 2000 square feet of conditioned floor area.

Table R406.2 Summary

<table>
<thead>
<tr>
<th>Option</th>
<th>Description</th>
<th>Credit(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1a</td>
<td>Efficient Building Envelope 1a</td>
<td>0.5</td>
</tr>
<tr>
<td>1b</td>
<td>Efficient Building Envelope 1b</td>
<td>1.0</td>
</tr>
<tr>
<td>1c</td>
<td>Efficient Building Envelope 1c</td>
<td>2.0</td>
</tr>
<tr>
<td>2a</td>
<td>Air Leakage Control and Efficient Ventilation 2a</td>
<td>0.5</td>
</tr>
<tr>
<td>2b</td>
<td>Air Leakage Control and Efficient Ventilation 2b</td>
<td>1.0</td>
</tr>
<tr>
<td>3a</td>
<td>High Efficiency HVAC 3a</td>
<td>0.5</td>
</tr>
<tr>
<td>3b</td>
<td>High Efficiency HVAC 3b</td>
<td>1.0</td>
</tr>
<tr>
<td>3c</td>
<td>High Efficiency HVAC 3c</td>
<td>2.0</td>
</tr>
<tr>
<td>3d</td>
<td>High Efficiency HVAC 3d</td>
<td>1.0</td>
</tr>
<tr>
<td>4</td>
<td>High Efficiency HVAC Distribution System</td>
<td>1.0</td>
</tr>
<tr>
<td>5a</td>
<td>Efficient Water Heating</td>
<td>0.5</td>
</tr>
<tr>
<td>5b</td>
<td>Efficient Water Heating</td>
<td>1.5</td>
</tr>
<tr>
<td>6</td>
<td>Renewable Electric Energy</td>
<td>0.5</td>
</tr>
</tbody>
</table>

Total Credits: 0.00

*Please refer to Table R406.2 for complete option descriptions.

R403.6 Equipment Sizing (Mandatory)

Heating and cooling equipment shall be sized in accordance with ACCA Manual S based on building loads calculated in accordance with ACCA Manual J or other approved methodology.

You want, how many BTU’s?
### Glazing Schedule

#### Vertical Glazing (Windows and glazed doors)

<table>
<thead>
<tr>
<th>Plan ID</th>
<th>Component Description</th>
<th>Ret</th>
<th>U-factor</th>
<th>Glazing Width</th>
<th>Height</th>
<th>Glazing Area</th>
<th>U</th>
<th>L/A</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**R402.3.3 Exception (15 sq. ft. max.)**

**Sum of Area and L/A**

Area Weighted U = U/A

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0.0 0.00</td>
</tr>
<tr>
<td></td>
<td>0.0 0.00</td>
</tr>
<tr>
<td></td>
<td>0.0 0.00</td>
</tr>
<tr>
<td></td>
<td>0.0 0.00</td>
</tr>
</tbody>
</table>

65
Simple Heating System Size: Washington State

This heating system sizing calculator is based on the Prescriptive Requirements of the 2012 Washington State Energy Code (WSEC) and ACCA Manuals 7 and S. This calculator will calculate heating loads only. ACCA procedures for sizing cooling systems should be used to determine cooling loads.

The glazing (window) and door portion of this calculator assumes the installed glazing and door products have an area weighted average U-factor of 0.30. The incorporated insulation requirements are the minimum prescriptive amounts specified by the 2012 WSEC.

Please fill out all of 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 call the WSU Energy Extension Program at (360) 503-2342 for assistance.

### Project Information

<table>
<thead>
<tr>
<th>Field</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Contact Information

<table>
<thead>
<tr>
<th>Field</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Heating System Type:

- [ ] All Other Systems
- [ ] Heat Pump

### Design Temperature

- Design Temperature Difference (AT) = \( T_{in} \) - \( T_{out} \)

### Area of Building

- Conditioned Floor Area
  - \( \text{Area (sq ft)} \)
- Average Ceiling Height
  - \( \text{Height (ft)} \)

### Glazing and Doors

- \( U \)-Factor
  - \( X \) \( \text{Area} = \text{UA} \)

### Skylights

- \( U \)-Factor
  - \( X \) \( \text{Area} = \text{UA} \)

### Insulation

- Attic
  - \( U \)-Factor
  - \( X \) \( \text{Area} = \text{UA} \)

- Single Rafter or Jutted Vaulted Ceilings
  - \( U \)-Factor
  - \( X \) \( \text{Area} = \text{UA} \)

- Above Grade Walls (see Figure 1)
  - \( U \)-Factor
  - \( X \) \( \text{Area} = \text{UA} \)

- Floors
  - \( U \)-Factor
  - \( X \) \( \text{Area} = \text{UA} \)

- Below Grade Walls (see Figure 1)
  - \( U \)-Factor
  - \( X \) \( \text{Area} = \text{UA} \)

- Slab Above Grade
  - \( F \)-Factor
  - \( X \) \( \text{Length} = \text{UA} \)

- Slab on Grade (see Figure 1)
  - \( F \)-Factor
  - \( X \) \( \text{Length} = \text{UA} \)

### Location of Ducts

- Select Location of Ducts

### Duct Leakage Coefficient

- \( \text{Sum of UA} \)
- \( \text{Envelope Heat Load} \)
- \( \text{All Leakage Heat Load} \)
- \( \text{Building Design Heat Load} \)
- \( \text{Building and Duct Heat Loss} \)
- \( \text{Maximum Heat Equipment Output} \)

---

**Figure 1**

[Image of a building with above grade and below grade walls]
# Window, Skylight and Door Schedule

## Project Information

<table>
<thead>
<tr>
<th>Contact Information</th>
</tr>
</thead>
</table>

## Exempt Items

- **Exempt Swinging Door (24 sq. ft. max.)**
- **Exempt Glazed Fenestration (15 sq. ft. max.)**

## Vertical Fenestration (Windows and doors)

<table>
<thead>
<tr>
<th>Component Description</th>
<th>Ref.</th>
<th>U-factor</th>
<th>Width (Feet)</th>
<th>Height (Inch)</th>
<th>Area</th>
<th>UA</th>
</tr>
</thead>
<tbody>
<tr>
<td>den / bedroom 1 / bed 2</td>
<td></td>
<td>0.30</td>
<td>8</td>
<td>3 6</td>
<td>144.0</td>
<td>43.20</td>
</tr>
<tr>
<td>bathroom</td>
<td></td>
<td>0.30</td>
<td>1</td>
<td>2 4</td>
<td>8</td>
<td>2.40</td>
</tr>
<tr>
<td>Living Room</td>
<td></td>
<td>0.30</td>
<td>3</td>
<td>3 6</td>
<td>54.0</td>
<td>16.20</td>
</tr>
<tr>
<td>Kitchen / Laundry</td>
<td></td>
<td>0.40</td>
<td>2</td>
<td>3 4 6</td>
<td>27.0</td>
<td>10.80</td>
</tr>
<tr>
<td>Entry Door / Garage Door / den door</td>
<td>0.20</td>
<td></td>
<td>3 3 8</td>
<td></td>
<td>72.0</td>
<td>14.40</td>
</tr>
</tbody>
</table>
### Overhead Glazing (Skylights)

<table>
<thead>
<tr>
<th>Component Description</th>
<th>Ref.</th>
<th>U-factor</th>
<th>Qt. Feet</th>
<th>Height Feet Inch</th>
<th>Area</th>
<th>UA</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Sum of Overhead Glazing Area and UA**

\[
\text{Overhead Glazing Area Weighted } U = \frac{\text{UA}}{\text{Area}}
\]

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Total Sum of Fenestration Area and UA</strong> (for heating system sizing calculations)</td>
<td>305.0</td>
</tr>
</tbody>
</table>
The glazing (window) and door portion of this calculator assumes the installed glazing and door products have an area weighted average U-factor of 0.30. The incorporated insulation requirements are the minimum prescriptive amounts specified by the 2012 WSEC. Please fill out all of 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 call the WSU Energy Extension Program at (360) 956-2042 for assistance.

### Heating System Type:

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

#### Design Temperature

- **Design Temperature Difference (ΔT)**: 48°F
  \[ ΔT = \text{Indoor (70 degrees)} - \text{Outdoor Design Temp} \]

#### Area of Building

- **Conditioned Floor Area**
  - **Instructions**: Conditioned Floor Area (sq ft)
  - **Value**: 1,734 sq ft

- **Average Ceiling Height**
  - **Instructions**: Average Ceiling Height (ft)
  - **Value**: 8.0 ft

#### Glazing and Doors

- **U-Factor**
  - **Instructions**
  - **Value**: 0.30
  - **Area**: 305 sq ft
  - **UA**: 91.50

#### Skylights

- **U-Factor**
  - **Instructions**
  - **Value**: 0.50
  - **Area**: ---

#### Insulation

- **Attic**
  - **Instructions**
  - **Value**: R-49
  - **U-Factor**: 0.026
  - **Area**: 1,734 sq ft
  - **UA**: 45.08
Insulation

Attic
Instructions
R-49

U-Factor X Area = UA
0.026 X 1,734 = 45.08

Single Rafter or Joist Vaulted Ceilings
Instructions
Select R-Value

No selection

Above Grade Walls (see Figure 1)
Instructions
R-21 Intermediate

U-Factor X Area = UA
0.056 X 1,055 = 59.08

Floors
Instructions
R-30

U-Factor X Area = UA
0.029 X 1,734 = 50.29

Below Grade Walls (see Figure 1)
Instructions
Select R-value

No selection

Slab Below Grade (see Figure 1)
Instructions
Select conditioning

No selection

Slab on Grade (see Figure 1)
Instructions
Select R-Value

No selection

Location of Ducts
Instructions
Unconditioned Space

Duct Leakage Coefficient 1.10

Figure 1.

Envelope Heat Load
Sum of UA X ΔT
11,806 Btu / Hour

Air Leakage Heat Load
Volume X 0.6 X ΔT X 0.018
7,191 Btu / Hour

Building Design Heat Load
Air Leakage + Envelope Heat Loss
18,997 Btu / Hour

Building and Duct Heat Load
Ducts in unconditioned space: Sum of Building Heat Loss X 1.10
Ducts in conditioned space: Sum of Building Heat Loss X 1
20,897 Btu / Hour

Maximum Heat Equipment Output
Building and Duct Heat Loss X 1.40 for Forced Air Furnace
29,255 Btu / Hour
Washington State Energy Code

Required Credits

- Identify size of project
  - Points: 8
  - Points: 1.4
  - Points: 2.6

Credits

- Prescriptive method plus
  - U-28 wall, R-1.5 ceiling, R-1.0 slab
  - Points: 5

Marine 4C 2012 Prescriptive Envelope Requirements

<table>
<thead>
<tr>
<th>Walls</th>
<th>Ceiling</th>
<th>Floor</th>
<th>Basement Wall</th>
<th>Slab</th>
<th>Mass wall</th>
<th>Glazing</th>
<th>Skylight</th>
<th>SHGC</th>
</tr>
</thead>
<tbody>
<tr>
<td>R21</td>
<td>R49</td>
<td>R30</td>
<td>R10/15/21 int</td>
<td>R10</td>
<td>21/21</td>
<td>U.30</td>
<td>U.50</td>
<td>n/a</td>
</tr>
</tbody>
</table>

HVAC Summary

<table>
<thead>
<tr>
<th>Model</th>
<th>CFM</th>
<th>BTUs</th>
<th>Efficiency rating</th>
<th>HRV yes/no</th>
<th>OSA</th>
<th>OSA duct size</th>
</tr>
</thead>
</table>

Exhaust and Whole House Ventilation

<table>
<thead>
<tr>
<th>Location</th>
<th>CFM</th>
<th>Duct size</th>
<th>Timer</th>
<th>Whole house ventilation type</th>
</tr>
</thead>
</table>

HVAC Duct Sizing

<table>
<thead>
<tr>
<th>Trunk size</th>
<th>Bedroom branches</th>
<th>Living room</th>
<th>Utility</th>
<th>Bathrooms</th>
<th>Other</th>
</tr>
</thead>
</table>

Notes
Whole House Ventilation Systems

Four ventilation options from 2012 IRC WAC’s

Exhaust fan  
M1507.3.4

Option 1

Integrated to HVAC  
M1507.3.5

Option 2
Exhaust Fan Ventilation Systems

Advantages of this system
- Easy to install
- Low cost application
- Can be very quiet

System drawbacks
- May not perform well
- Sometimes noisy despite <1.0 sone requirement
- Homeowner sabotage
Integrated Forced Air System

SCREENED FRESH AIR INTAKE GRILLE

INSULATED DUCT

TAKEOFF COLLAR

DAMPER**

AIR RETURN SIDE OF HEATING SYSTEM

24 HOUR TIMER WITH ON/OFF SWITCH WIRED PARALLEL TO FURNACE FAN

FURNACE

**MANUAL DAMPER REQUIRED. MOTORIZED DAMPER RECOMMENDED IN SOME LOCATIONS.
Whole House Ventilation Systems

Supply fan
M1507.3.6
Option 3

HRV system
M1507.3.7
Option 4
Ventilation Using a Supply Fan

- Supply Duct
- Supply Filter
- In-line Supply Fan
- Fresh Air Duct (insulation required if indoors)
- Return Duct
- Forced Air Furnace
- 24 hour timer (operates the supply fan only)
Heat Recovery Ventilation

Outside Air

Return Air From Home

Exhaust Air To Outside

Supply Air To Home
IRC M1507.3.1 Whole House Ventilation System

Each dwelling or guestroom shall be equipped with a ventilation system

WSEC, R403.5.1 Whole house ventilation system fan efficacy shall comply with Table R403.5.1

<table>
<thead>
<tr>
<th>FAN LOCATION</th>
<th>AIR FLOW RATE MINIMUM (CFM)</th>
<th>MINIMUM EFFICACY (CFM/WATT)</th>
<th>AIR FLOW RATE MAXIMUM (CFM)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Range hoods</td>
<td>Any</td>
<td>2.8 cfm/watt</td>
<td>Any</td>
</tr>
<tr>
<td>In-line fan</td>
<td>Any</td>
<td>2.8 cfm/watt</td>
<td>Any</td>
</tr>
<tr>
<td>Bathroom, utility room</td>
<td>10</td>
<td>1.4 cfm/watt</td>
<td>≤ 90</td>
</tr>
<tr>
<td>Bathroom, utility room</td>
<td>90</td>
<td>2.8 cfm/watt</td>
<td>Any</td>
</tr>
</tbody>
</table>

* This references minimum fan efficacy (cfm per watt)
M1507.3.2 Control and Operation

1. Controls for all ventilation systems shall be readily accessible by occupant

2. Operating instructions shall be provided to occupant from the installer

3. Exhaust systems shall be controlled by manual switches, timers, de-humidistat, or other approved means

4. Continuous whole house ventilation systems shall operate continuously. Fans shall be equipped with ‘fan on’ override controls. A label shall be affixed stating: ‘whole house ventilation’ see instructions
M1507.3.2 Control and Operation (cont’d)

5. Intermittent whole house ventilation systems shall comply with the following;

5.1 Capable of operating intermittently or continuously

5.2 Controls capable of operating the fans

5.3 Adjustable ventilation rate

5.4 Be capable of operating automatically on a timer

5.5 Intermittent system shall operate at least 1hr every 4hrs

5.6 Controls shall be 24-hour clock timer capable

5.7 At final system shall be set to operate per schedule used for fan sizing

5.8 A label is affixed that reads ‘whole house ventilation’

see instructions
M1507.3.2.1 Operating Instructions

Installers shall provide operating instructions for HVAC and whole house ventilation systems.

For more information on ventilation

See “New Fresh Air for a Healthier Home”
Whole house ventilation shall provide outdoor air to each habitable space at a continuous rate not less than Table M1507.3.3 (1)

**Exception:**
The ventilation system is permitted to operate intermittently where the system has controls that enable operation not less than 25% of each 4-hr segment and the rate above is multiplied by the factor from Table M1507.3.3 (2)
M1507.3.3 Mechanical Ventilation Rate

Example:

2,000sq.ft. dwelling / 3bdrm
Table M1507.3.3 (1) requires 60 cfm continuous ventilation rate

For intermittent ventilation you take 60 cfm x 4 = 240 cfm

Result:
Ventilation rate of 240 cfm, 6 times per day
M1507.3.4 Exhaust fan ventilation

M1507.3.4.2 Fan located 4-feet or less from interior grille shall have sone rating of 1.0 or less.

Remotely mounted fans shall be acoustically isolated from structural elements and attached ducts using flex duct or other approved material.
M1507.3.4.4 Outdoor air inlets

Outdoor air inlets shall be distributed to each habitable space.

Where outdoor air inlets are separated from exhaust points doors shall be undercut ½” minimum or other approved method

Outdoor air inlets shall:
• Have controllable and secure openings
• Be sleeved or designed not to compromise thermal properties of the wall or window
• Provide not less than 4 sq.in. of net free area for each habitable space
• Air inlets shall be screened
Outdoor air inlets shall not be located in any of the following locations:

1. Closer than 10-ft from appliance vent, unless vent is 3-ft above inlet

2. Where it will pick up objectionable odors, fumes or flammable vapors

3. Hazardous or unsanitary locations

4. Space with fuel burning appliances

5. Closer than 10-ft to plumbing vent opening, unless vent if 3-ft above inlet

6. Attics, crawl spaces, or garages

Same requirements for all four styles of OSA intake.
M1507.3.5 Integrated with forced air systems

Outdoor ventilation rate shall be provided per M1507.3.3

Outdoor air shall be provided to each habitable space through the forced air duct system

The outdoor air inlet shall be located in the return and within 4-ft upstream of air handler

The outdoor air shall be upstream of forced air system blower to prevent thermal shock to heat exchanger

The system shall be provided with a motorized damper

Required flow rate shall be verified by field testing

Supply ducts shall be a minimum of R-4 in conditioned space
Supply fan capacity shall comply with M1507.3.3

The outdoor air shall be filtered

The outdoor air inlet shall be connected to either the supply or return air stream.

The outdoor air connection shall be downstream of system blower.

The outdoor air duct connection to return air shall be located 4-ft upstream of system blower and filter.

To prevent thermal shock to the heat exchanger, the supply duct shall not be connected directly to the furnace cabinet.
M1507.3.6 Supply fan ventilation (cont’d)

The outdoor air inlet duct shall be sized per Table M1507.3.6.2

<table>
<thead>
<tr>
<th>Specified Volume from Table M1507.3.3(1)</th>
<th>Minimum Smooth Duct Diameter</th>
<th>Minimum Flexible Duct Diameter</th>
</tr>
</thead>
<tbody>
<tr>
<td>50-90 cfm</td>
<td>4 inch</td>
<td>5 inch</td>
</tr>
<tr>
<td>90-150 cfm</td>
<td>5 inch</td>
<td>6 inch</td>
</tr>
<tr>
<td>150-120 cfm</td>
<td>6 inch</td>
<td>7 inch</td>
</tr>
<tr>
<td>250-400 cfm</td>
<td>7 inch</td>
<td>8 inch</td>
</tr>
</tbody>
</table>

The terminal element on the outside of the building shall be 2-inches larger than the outdoor air inlet duct.
M1507.3.6 Supply fan ventilation (cont’d)

M1507.3.6.3 Dampers
The systems shall be equipped with a back draft dampers and one of the following:

1. A calibrated manual volume damper set to meet the requirements of Table M1507.3.3 (1) and field tested with a pressure gauge or flow hood

OR

2. An automatic flow regulating device set to meet the requirements of Table M1507.3.3 (1)
M1507.3.7 Heat Recovery system (HRV)

All duct work shall be sized and installed per manufacturer’s instructions.

System minimum flow rate shall be per Table M1507.3.3 (1).

The system shall have a filter on upstream side of heat exchangers in both the intake and exhaust airstreams with a (MERV) 6 filter.

Supply ducts in conditioned spaces shall be installed upstream of heat exchangers and insulated to minimum of R-4.
M1507.4 Local Exhaust

Local exhaust shall be installed in kitchens, bathrooms, water closets, laundry rooms, indoor swimming pools, spas, and other rooms where water vapor or cooking odors are produced.

For really large Kitchen Range Hoods see:

M1503.4 Makeup air required. Exhaust hood systems capable of exhausting in excess of **400 cubic feet per minute** (0.19 m³/s) shall be provided with makeup air at a rate approximately equal to the exhaust air rate. Such makeup air systems shall be equipped with a means of closure and shall be automatically controlled to start and operate simultaneously with the exhaust system.
Local exhaust shall be designed to meet the minimum air flow per Table M1507.4.

**TABLE M1507.4**

MINIMUM REQUIRED LOCAL EXHAUST RATES FOR ONE- AND TWO-FAMILY DWELLINGS

<table>
<thead>
<tr>
<th>AREA TO BE EXHAUSTED</th>
<th>EXHAUST RATES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kitchens</td>
<td>100 cfm intermittent or 25 cfm continuous</td>
</tr>
<tr>
<td>Bathrooms—toilet rooms</td>
<td>Mechanical exhaust capacity of</td>
</tr>
<tr>
<td>Laundry rooms</td>
<td>50 cfm intermittent or 20 cfm continuous</td>
</tr>
<tr>
<td>Indoor swimming pools &amp; spas</td>
<td></td>
</tr>
</tbody>
</table>

Local exhaust shall be controlled by manual switches, de-humidistats, timers or other approved means.

Local exhaust system controls shall be readily accessible.
For additional information and updates go to the Washington State Building Code Council Website:
https://fortress.wa.gov/ga/apps/sbcc/default.aspx

WSU Extension Energy Program code experts provide support to those who use the **residential sections** of the Washington State Energy Code (WSEC). The 2012 code went into effect July 1, 2013 for updates go to:

**Have questions about the residential code?**
Email energycode@energy.wsu.edu or call the WSEC Residential Code Hotline at 360-956-2042.

Additional information available on the Southwest Washington ICC website:
http://sww-icc.org/
Questions?