Residential Energy Provisions: from Design to Plans to the Field
Hope Medina, CSP, CBO
Shums Coda Associates

WHEN IS IT RESIDENTIAL?

RESIDENTIAL BUILDING.
For this code, includes detached one- and two-family dwellings and multiple single family dwellings (townhouses) and Group R-2, R-3 and R-4 buildings three stories or less in height above grade plane.

COMMERCIAL BUILDING.
For this code, all buildings that are not included in the definition of “Residential building.”

Hope Medina, CSP & CBO- Instructor
- Hold multiple International Code Council(ICC) certifications
- Active participant in the code development process
- Active participant in the standard development process
- Member of ICC Sustainability Membership Council
- Present at many conference, summits, and other events
- Speaker and guests on various podcasts and radio broadcast

IECC
- Chapter 1 – Scope and Administration
- Chapter 2 – Definitions
- Chapter 3 – General Requirements
- Chapter 4 – Residential Efficiency
- Chapter 5 – Existing Buildings
- Chapter 6 – Reference Standards
• Chapter 1 – Scope and Administration
• Chapter 2 – Definitions
• Chapter 3 – General Requirements
• Chapter 4 – Residential Efficiency
  • R401 – General
  • R402 – Building Thermal Envelope
  • R403 – Systems
  • R404 – Electrical Power and Lighting Systems
  • R405 – Total Building Performance
  • R406 – Energy Rating Index
  • R407 – Tropical Climate Region Compliance Path
  • R408 – Additional Efficiency Package Options
• Chapter 5 – Existing Buildings
• Chapter 6 – Reference Standards

LET'S LOOK AT THE APPENDICE CHAPTERS
• RA Board of Appeals
• RB Solar Ready Provisions
• RC Zero Energy Residential Building Provisions

ONLY APPLICABLE IF ADOPTED

LET'S LOOK AT THE ADMIN CHAPTER
MORE SPECIFICALLY R103

R103.2 Information on construction documents.
Construction documents shall be drawn to scale on suitable material. Electronic media documents are permitted to be submitted where 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. Details shall include the following as applicable:

1. Energy Compliance Path
2. Insulation materials and their R-values.
4. Area-weighted U-factor and solar heat gain coefficients (SHGC) calculations.
5. Mechanical system design criteria.
6. Mechanical and service water-heating systems and equipment types, sizes and efficiencies.
7. Equipment and system controls.
8. Duct sealing, duct and pipe insulation and location.

R103.2.1 – Define the Thermal Envelope
R401.2 Application.
Residential buildings shall comply with Section R401.2.5 and either
Sections R401.2.1, R401.2.2, R401.2.3 or R401.2.4.
Exception: Additions, alterations, repairs and changes of occupancy
to existing buildings complying with Chapter 5.

Energy Compliance Paths 2021

PRESCRIPTIVE
R-Value Alternative
Total UA Alternative

TOTAL BUILDING PERFORMANCE
No On-site Renewable Energy

ENERGY RATING INDEX (ERI)
On-site Renewable Energy

2021 Insulation and Fenestration Criteria Option
The Concepts

• This option uses the entire assembly to demonstrate compliance
• 2021 Table R402.1.2 provides the assembly components that must meet the values listed
• Table R402.1.4 is still required for slab edge insulation and the fenestration SHGC requirements
• This approach is not often used
2021 Insulation and Fenestration Criteria Option
The Concepts

Assembly approach - adding each component to the equation

Remember the lower the U-factor the better

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Example

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Example
### Example

<table>
<thead>
<tr>
<th>Material</th>
<th>R-value at isolation</th>
<th>R-value of Steel</th>
</tr>
</thead>
<tbody>
<tr>
<td>Air Film</td>
<td>0.08</td>
<td>-</td>
</tr>
<tr>
<td>Plywood Edging</td>
<td>0.09</td>
<td>0.15</td>
</tr>
<tr>
<td>Wood</td>
<td>0.15</td>
<td>0.15</td>
</tr>
<tr>
<td>Insulation board</td>
<td>0.17</td>
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</tr>
<tr>
<td>R-1.5 Flat or wood stud</td>
<td>0.95</td>
<td>0.95</td>
</tr>
<tr>
<td>1/2&quot; gypsum board</td>
<td>0.08</td>
<td>0.08</td>
</tr>
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<td>Air Film</td>
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</tr>
<tr>
<td><strong>Total</strong></td>
<td>19.37</td>
<td>10.83</td>
</tr>
</tbody>
</table>

*Assume a closing factor of 50% (the area of the wall that inspires)*

Average: $R = (0.80 \times 15.27) + (0.20 \times 10.82) = 15.40 + 2.16 = 17.57$

$k = 0.73$; $B = 0.33$

**k-value = 3.33 (0.047)**

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**k-value = 3.33 (0.047)**
Now we have to determine how much wood is in the wall. (Framing Factor)

Example

The Framing Factor is 20%
Which means that 20% of the wall is made up of where the wood is located and 80% of the wall is the cavity insulation

(.80 x 19.27) + (.20 x 10.82) = 15.41 + 2.16 = 17.57 (R-Value)
How to convert an R-Value into a U-Factor

\[ \frac{1}{R-Value} = U-Factor \]

Example

\[ (.80 \times 19.27) + (.20 \times 10.82) = 15.41 + 2.16 = 17.57 \text{(R-Value)} \]

REMEMBER U-Factors are the maximum value permitted by code

U-FACTOR ALTERNATIVE

• No trade-off
• By the book
• Everything on the plans
• Documentation of assembly values

• Comply with R401- R404
• Thermal Envelope based off of Table R402.1.2 except for slab edge and SHGC requirements come from Table R402.1.3(2021) – R-Value Table

Total UA Alternative Option
The Concepts

• This option allows for trading of the thermal envelope components
• Twin building concept
• Table R402.1.2(2021) is utilized to show compliance through calculations
• Table R402.1.3(2021) is still required for slab edge insulation and the fenestration SHGC requirements, and these are not permitted to be traded
• This approach is used a lot
Total UA Alternative Option (3)
The Concepts

- Prescriptive U-Factor values of the thermal envelope assemblies found in Table R402.1.2(2021)

TWIN BUILDING CONCEPT

- Use the proposed values of the thermal envelope assemblies found in Table R402.1.2

PROPOSED DESIGN

REFERENCED DESIGN

If the U-Factor of the Proposed Design is equal to or less than the sum of the Referenced Design, it is considered to be compliant.

Reference Design U ≥ U Proposed Design

The fenestration SHGC must also be met
Slab edge insulation must also be met
These two items cannot be traded
TOTAL UA ALTERNATIVE

- By the book - except for............
- Trade off allowed for the thermal envelope
- Comply with R401- R404
- Thermal Envelope requirements based on R402.1.5
- Everything on the plans and should match the REScheck Values and Manual J
- REScheck Compliance Certificate or other approved software generated report

TOTAL BUILDING PERFORMANCE- Residential

- Method for whole building/house performance trade offs
- Twin building concept – Reference design and Proposed design
- Tables determine what can be traded in the design
- Annual Energy Cost determines compliance

REFERENCE DESIGN HOUSE
- Geometric twin
- Values from Values from Table R405.4.2(1)

PROPOSED HOUSE
- Geometric twin
- Envelope U-factors based on builder’s proposed design
ENERGY RATING INDEX COMPLIANCE ALTERNATIVE – ERI R406 – OVERALL CONCEPT

- Geometric Twin Concept
- 2006 IECC prescriptive requirements for reference design home
- Number shows compliance
- Thermal envelope requirements

ENERGY RATING INDEX CONCEPT -2021

- Comply with Table R406.2
- Thermal envelope equation
  - Onsite renewable included
  - Onsite renewable not included
- Comply with Table R406.5
- Two Compliance reports
  - Based on plans report at submittal
  - Actual report for issuance of CO
- Verified by approved third party
- Software tool requirements
- Renewable energy certificate (REC)

1. Energy Compliance Path
2. Insulation materials and their R-values.
4. Area-weighted U-factor and solar heat gain coefficients (SHGC) calculations.
5. Mechanical system design criteria.
6. Mechanical and service water-heating systems and equipment types, sizes and efficiencies.
7. Equipment and system controls.
8. Duct sealing, duct and pipe insulation and location.

R103.2.1 – Define the Thermal Envelope
• Locate completely outside of thermal envelope or
• Insulate walls, ceiling, and floors to values in Table R402.1.2(2018) or R402.1.3(2021)
• Utilize sealing of the room
• Doors gasketed no louvers
• Duct work and water lines in room shall be insulated

THERMAL vs. SOUND
1. Energy Compliance Path
2. Insulation materials and their R-values.
4. Area-weighted U-factor and solar heat gain coefficients (SHGC) calculations.
5. Mechanical system design criteria.
6. Mechanical and service water-heating systems and equipment types, sizes and efficiencies.
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**R103.2.1 – Define the Thermal Envelope**

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**INSULATION**

- **Fiberglass Batts**
  - R- 3.0 – 3.8
- **Fiberglass Blown in**
  - R- 2.2 – 3.5
- **Expanded Polystyrene Insulation (EPS)**
  - R-3.4 – 3.9
- **Polyisocyanurate**
  - R- 6.2 – 7.2
- **Extruded Polystyrene (XPS)**
  - R- 4.7
- **Cellulose Blown in**
  - R- 3.2 – 3.8
- **Open-cell Spray Foam**
  - R- 3.5 – 4.2
- **Closed-cell Spray Foam**
  - R- 6.0 – 7.0

High Average of R-Values for Various Insulation Types

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**Estimated R-values for Insulation Compressed into Framing Cavities**

<table>
<thead>
<tr>
<th>Insulation Thickness</th>
<th>R- 40</th>
<th>R- 30</th>
<th>R- 20</th>
<th>R- 15</th>
<th>R- 12</th>
<th>R- 10</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 1/2&quot;</td>
<td>6.0</td>
<td>5.5</td>
<td>4.8</td>
<td>4.5</td>
<td>4.2</td>
<td>3.9</td>
</tr>
<tr>
<td>2 1/4&quot;</td>
<td>6.5</td>
<td>6.0</td>
<td>5.4</td>
<td>5.0</td>
<td>4.7</td>
<td>4.4</td>
</tr>
<tr>
<td>1&quot;</td>
<td>7.5</td>
<td>7.0</td>
<td>6.3</td>
<td>5.9</td>
<td>5.7</td>
<td>5.4</td>
</tr>
<tr>
<td>2&quot;</td>
<td>8.5</td>
<td>8.0</td>
<td>7.3</td>
<td>6.9</td>
<td>6.7</td>
<td>6.4</td>
</tr>
<tr>
<td>3&quot;</td>
<td>9.5</td>
<td>9.0</td>
<td>8.3</td>
<td>7.9</td>
<td>7.7</td>
<td>7.4</td>
</tr>
<tr>
<td>4&quot;</td>
<td>10.5</td>
<td>10.0</td>
<td>9.3</td>
<td>8.9</td>
<td>8.7</td>
<td>8.4</td>
</tr>
<tr>
<td>5&quot;</td>
<td>11.5</td>
<td>11.0</td>
<td>10.3</td>
<td>9.9</td>
<td>9.7</td>
<td>9.4</td>
</tr>
<tr>
<td>6&quot;</td>
<td>12.5</td>
<td>12.0</td>
<td>11.3</td>
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**High Average of R-Values for Various Insulation Types**

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**High Average of R-Values for Various Insulation Types**

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**High Average of R-Values for Various Insulation Types**

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**High Average of R-Values for Various Insulation Types**
Grading System
Meet ASTM-specified installation requirements in the applicable standards C1015, C1320 and ASTM C1848 – RESNET/ICC

Grade 1
- It completely fills the cavity-side to-side and top to bottom. In the case of air-permeable insulation, it is encapsulated on six sides. It’s cut around electrical junction boxes, split around wires and pipes, and generally not compressed.
- No moderate or substantial defects

Grade 2
- There’s some imperfections in the installation but overall, it’s still not too bad.

Grade 3
- It has “substantial gaps and voids.”

INSULATION MARKING 303.1.1
- An R-value identification mark shall be applied by the manufacturer to each piece of building thermal envelope insulation 12 inches (305 mm) or greater in width. R303.1.1
- Insulating materials shall be installed such that the manufacturer’s R-value mark is readily observable upon inspection. R303.1.2

INSULATION CERTIFICATE R303.1.1
- TYPE, MANUFACTURER, AND R-VALUE
- BLOWN INSULATION
  - INITIAL THICKNESS
  - SETTLED THICKNESS
  - SETTLED R-VALUE
  - INSTALLED DENSITY
  - COVERAGE AREA WITH THE NUMBER OF BAGS INSTALLED
- SPRAY FOAM
  - INSTALLED THICKNESS WITH R-VALUE
- INSULATED SIDING
  - R-VALUE ON PRODUCT PACKAGING
- INSTALLER MUST SIGN
- POST IN A CONSPICUOUS LOCATION
**TABLE R402.1.3 INSULATION MINIMUM R-VALUES AND FENESTRATION REQUIREMENTS BY COMPONENT**

<table>
<thead>
<tr>
<th>CLIMATE ZONE</th>
<th>CEILING R-VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>30</td>
</tr>
<tr>
<td>1</td>
<td>30</td>
</tr>
<tr>
<td>2</td>
<td>49</td>
</tr>
<tr>
<td>3</td>
<td>49</td>
</tr>
<tr>
<td>4 except Marine</td>
<td>60</td>
</tr>
<tr>
<td>5 and Marine</td>
<td>60</td>
</tr>
<tr>
<td>6</td>
<td>60</td>
</tr>
<tr>
<td>7 and 8</td>
<td>60</td>
</tr>
</tbody>
</table>

**R402.2.1 CEILINGS WITH ATTICS.**

- If Table R402.1.3 requires an R-60 you can use an R-49 if the R-49 Extends over the top plate – Example Above deck roof insulation design
- Only permitted for the R-value Alternative option of the prescriptive path
R402.2.2 CEILINGS WITHOUT ATTICS.

- Space is restricted for full insulation
- R-30 permitted
- If extends over top plate to outer edge
- Not compressed
- Only allows for 500 SQFT or 20% of ceiling area
- Only permitted for the R-value
  Alternative option of the prescriptive path

OTHER ROOFS TYPES TO BE AWARE OF
R402.2.3 EAVE BAFFLE

For air-permeable insulation in vented attics, a baffle shall be installed adjacent to soffit and eave vents. Baffles shall maintain a net free area opening equal to or greater than the size of the vent. The baffle shall extend over the top of the attic insulation. The baffle shall be permitted to be any solid material. The baffle shall be installed to the outer edge of the exterior wall top plate so as to provide maximum space for attic insulation coverage over the top plate. Where soffit venting is not continuous, baffles shall be installed continuously to prevent ventilation air in the eave soffit from bypassing the baffle.
Attic Insulation Marking
R303.1.1.1
- Thickness of insulation on markers every 300 sq ft.
- Markers have 1 inch minimum in height
- Shall face attic access opening
- Foam thickness listed on certificate

Wall Insulation
- What is the insulation being used for?
- Material will matter
- Size of stud
- How was it installed

Table R402.1.3 Insulation Minimum R-Values and Fenestration Requirements by Component

<table>
<thead>
<tr>
<th>CLIMATE ZONE</th>
<th>WOOD FRAME WALL R-VALUE</th>
<th>CAVITY ONLY</th>
<th>CONTINUOUS ONLY</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>13 or 0 &amp; 10ci</td>
<td>All climate zones</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>13 or 0 &amp; 10ci</td>
<td>All climate zones</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>13 or 0 &amp; 10ci</td>
<td>All climate zones</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>20 or 13 &amp; 5ci</td>
<td>All climate zones</td>
<td></td>
</tr>
<tr>
<td>4 except Marine</td>
<td>30 or 20 &amp; 5ci or 13 &amp; 10ci or 0 &amp; 20ci</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5 and Marine 4</td>
<td>30 or 20 &amp; 5ci or 13 &amp; 10ci or 0 &amp; 20ci</td>
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<td></td>
</tr>
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<tr>
<th>CLIMATE ZONE</th>
<th>MASS WALL R-VALUE h</th>
<th>INTERIOR</th>
<th>EXTERIOR</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>3/4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>3/4</td>
<td>INTERIOR</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>4/6</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>8/13</td>
<td>USE THE 2ND NUMBER IN COLUMN</td>
<td>USE THE 1ST NUMBER IN COLUMN</td>
</tr>
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<td>4 except Marine</td>
<td>8/13</td>
<td></td>
<td></td>
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<td>19/21</td>
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h. Mass walls shall be in accordance with Section R402.2.5. The second R-value applies where more than half of the insulation is on the interior of the mass wall.

**R402.2.5 Mass walls.**

Mass walls where used as a component of the building thermal envelope shall be one of the following:

1. Above-ground walls of concrete block, concrete, insulated concrete form, masonry cavity, brick but not brick veneer, adobe, compressed earth block, rammed earth, solid timber, mass timber or solid logs.

2. Any wall having a heat capacity greater than or equal to 6 Btu/ft² × °F (123 kJ/m² × K).
R402.2.7 FLOORS.

Floor cavity insulation shall comply with one of the following:

1. Installation shall be installed to maintain permanent contact with the underside of the subfloor decking in accordance with manufacturer instructions to maintain required R-value or readily fill the available cavity space.

2. Floor framing cavity insulation shall be permitted to be in contact with the top side of sheathing separating the cavity and the unconditioned space below. Insulation shall extend from the bottom to the top of all perimeter floor framing members and the framing members shall be air sealed.

3. A combination of cavity and continuous insulation shall be installed so that the cavity insulation is in contact with the top side of the continuous insulation that is installed on the underside of the floor framing separating the cavity and the unconditioned space below. The combined R-value of the cavity and continuous insulation shall equal the required R-value for floors. Insulation shall extend from the bottom to the top of all perimeter floor framing members and the framing members shall be air sealed.
Crawlspace ventilation determine where the thermal envelope is located

Vented crawlspace - insulation at the floor location

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

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<tbody>
<tr>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>3 except Marine</td>
<td>5ci or 13'</td>
</tr>
<tr>
<td>4 and Marine</td>
<td>10ci or 13</td>
</tr>
<tr>
<td>5 and Marine</td>
<td>15ci or 19 or 13 &amp; 5ci</td>
</tr>
<tr>
<td>6</td>
<td>15ci or 19 or 13&amp; 5ci</td>
</tr>
<tr>
<td>7 and 8</td>
<td>15ci or 19 or 13 &amp; 5ci</td>
</tr>
</tbody>
</table>

c. “5ci or 13” means R-5 continuous insulation (ci) on the interior or exterior surface of the wall or R-13 cavity insulation on the interior side of the wall. “10ci or 13” means R-10 continuous insulation (ci) on the interior or exterior surface of the wall or R-13 cavity insulation on the interior side of the wall. “15ci or 19 or 13&5ci” means R-15 continuous insulation (ci) on the interior or exterior surface of the wall; or R-19 cavity insulation on the interior side of the wall; or R-13 cavity insulation on the interior of the wall in addition to R-5 continuous insulation on the interior or exterior surface of the wall.

g. The first value is cavity insulation; the second value is continuous insulation. Therefore, as an example, “13&5” means R-13 cavity insulation plus R-5 continuous insulation.

BASEMENT WALLS R402.2.8

BASEMENT WALL - defined as A wall 50 percent or more below grade and enclosing conditioned space.

- Walkout basements walls may be wood framed values and basement wall values

FR > 50% BW
Below Grade walls or basement wall insulation values

Less than 50% of wall below grade- now it's above grade wall value

---

R402.8 Basement walls.
Basement walls shall be insulated in accordance with Table R402.1.3.

**Exception:** Basement walls associated with unconditioned basements where all of the following requirements are met:

1. The floor overhead including the underside stairway stringer leading to the basement, is insulated in accordance with Section R402.1.3 and applicable provisions of Sections R402.2 and R402.2.7.
2. There are no uninsulated duct, domestic hot water, or hydronic heating surfaces exposed to the basement.
3. There are no HVAC supply or return diffusers serving the basement.
4. The walls surrounding the stairway and adjacent to conditioned space are insulated in accordance with Section R402.1.3 and applicable provisions of Section R402.2.
5. The door(s) leading to the basement from conditioned spaces are insulated in accordance with Sections R402.1.3 and applicable provisions of Section R402.2, and weatherstripped in accordance with Section R402.4.
6. The building thermal envelope separating the basement from adjacent conditioned spaces complies with Section R402.4.

R402.8.1 Basement wall insulation installation.
Where basement walls are insulated, the insulation shall be installed from the top of the basement wall down to 10 feet (3048 mm) below grade or to the basement.

---

<table>
<thead>
<tr>
<th>CLIMATE ZONE</th>
<th>SLAB R-VALUE &amp; DEPTH</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>3</td>
<td>10ci, 2 ft</td>
</tr>
<tr>
<td>4 except Marine</td>
<td>10ci, 4 ft</td>
</tr>
<tr>
<td>5 and Marine</td>
<td>10ci, 4 ft</td>
</tr>
<tr>
<td>6</td>
<td>10ci, 4 ft</td>
</tr>
<tr>
<td>7 and 8</td>
<td>10ci, 4 ft</td>
</tr>
</tbody>
</table>

d. R-5 insulation shall be provided under the full slab area of a heated slab in addition to the required slab edge insulation R-value for slabs as indicated in the table. The slab-edge insulation for heated slabs shall not be required to extend below the slab.

R402.9 Slab-on-grade floors.
Slab-on-grade floors with a floor surface less than 12 inches (305 mm) below grade shall be insulated in accordance with Table R402.1.3.

**Exception:** Slab-edge insulation is not required in jurisdictions designated by the code official as having a very heavy termite infestation.
R402.2.9.1 Slab-on-grade floor insulation installation.
Where installed, the insulation shall extend downward from the top of the slab on the outside or inside of the foundation wall. Insulation located below grade shall be extended the distance provided in Table R402.1.3 or the distance of the proposed design, as applicable, by any combination of vertical insulation, insulation extending under the slab or insulation extending away from the building. Insulation extending away from the building shall be protected by pavement or by not less than 10 inches (254 mm) of soil. The top edge of the insulation located between the exterior wall and the interior slab shall be permitted to be cut at a 45-degree (0.79 rad) angle away from the exterior wall.

PROTECTION OF EXPOSED FOUNDATION INSULATION 303.2.1
The protective covering shall cover the exposed exterior insulation and extend not less than 6 inches below grade.

SLAB EDGE IS NOT TRADEABLE
TABLE R402.1.3 INSULATION MINIMUM R-VALUES AND FENESTRATION REQUIREMENTS BY COMPONENT

<table>
<thead>
<tr>
<th>CLIMATE ZONE</th>
<th>CRAWL SPACE WALL R-VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>3</td>
<td>5ci or 13&quot;</td>
</tr>
<tr>
<td>4 except Marine</td>
<td>10ci or 13&quot;</td>
</tr>
<tr>
<td>5 and Marine</td>
<td>15ci or 19 or 13 &amp; 5ci</td>
</tr>
<tr>
<td>6</td>
<td>15ci or 19 or 13 &amp; 5ci</td>
</tr>
<tr>
<td>7 and 8</td>
<td>15ci or 19 or 13 &amp; 5ci</td>
</tr>
</tbody>
</table>

- **c.** “5ci or 13” means R-5 continuous insulation (ci) on the interior or exterior surface of the wall or R-13 cavity insulation on the interior side of the wall. “10ci or 13” means R-10 continuous insulation (ci) on the interior or exterior surface of the wall or R-13 cavity insulation on the interior side of the wall. “15ci or 19 or 13 & 5ci” means R-15 continuous insulation (ci) on the interior or exterior surface of the wall; or R-19 cavity insulation on the interior side of the wall; or R-13 cavity insulation on the interior of the wall in addition to R-5 continuous insulation on the interior or exterior surface of the wall.

- **f.** Basement wall insulation is not required in Warm Humid locations as defined by Figure R301.1 and Table R301.1.

- **g.** The first value is cavity insulation; the second value is continuous insulation. Therefore, as an example, “13 & 5” means R-13 cavity insulation plus R-5 continuous insulation.

---

**R402.2.10 Crawl space walls.**

Crawl space walls shall be insulated in accordance with Table R402.1.3. Exception: Crawl space walls associated with a crawl space that is vented to the outdoors and the floor overhead is insulated in accordance with Table R402.1.3 and Section R402.2.7.

**R402.2.10.1 Crawl space wall insulation installations.**

Where crawl space wall insulation is installed, it shall be permanently fastened to the wall and shall extend downward from the floor to the finished grade elevation and then vertically or horizontally for not less than an additional 24 inches (610 mm). Exposed earth in unvented crawl space foundations shall be covered with a continuous Class I vapor retarder in accordance with the International Building Code or International Residential Code, as applicable. Joints of the vapor retarder shall overlap by 6 inches (153 mm) and be sealed or taped. The edges of the vapor retarder shall extend not less than 6 inches (153 mm) up stem walls and shall be attached to the stem walls.
R402.2.10 CRAWL SPACE WALLS

Is it vented or unvented?

R402.2.4 ACCESS HATCHES AND DOORS.

Access hatches and doors from conditioned to unconditioned spaces such as attics and crawl spaces shall be insulated to the same R-value required by Table R402.1.3 for the wall or ceiling in which they are installed.

Exceptions:
1. Vertical doors providing access from conditioned spaces to unconditioned spaces that comply with the fenestration requirements of Table R402.1.3 based on the applicable climate zone specified in Chapter 3.
2. Horizontal pull-down, stair-type access hatches in ceiling assemblies that provide access from conditioned to unconditioned spaces in Climate Zones 0 through 4 shall not be required to comply with the insulation level of the surrounding surfaces provided the hatch meets all of the following:
   2.1. The average U-factor of the hatch shall be less than or equal to U-0.10 or have an average insulation R-value of R-10 or greater.
   2.2. Not less than 75 percent of the panel area shall have an insulation R-value of R-13 or greater.
   2.3. The net area of the framed opening shall be less than or equal to 13.5 square feet (1.25 m2).
   2.4. The perimeter of the hatch edge shall be weatherstripped.
   The reduction shall not apply to the total UA alternative in Section R402.1.5.
R402.2.12 SUNROOM AND HEATED GARAGE INSULATION.

Sunrooms enclosing conditioned space and heated garages shall meet the insulation requirements of this code.

**Exception:** For sunrooms and heated garages provided thermal isolation, and enclosed conditioned space, the following exceptions to the insulation requirements of this code shall apply:

1. The minimum ceiling insulation R-values shall be R-19 in Climate Zones 0 through 4 and R-24 in Climate Zones 5 through 8.
2. The minimum wall insulation R-value shall be R-13 in all climate zones. Walls separating a sunroom or heated garage with thermal isolation from conditioned space shall comply with the building thermal envelope requirements of this code.

Table 402.4.1.1
Component – Walls

- Cavities within corners and headers of frame walls shall be insulated by completely filling the cavity with a material having a thermal resistance of R3 per inch minimum
- Exterior thermal envelope insulation for framed walls shall be installed in substantial contact and continuous alignment with the air barrier

Table 402.4.1.1
Component – Walls

- Cavities within corners and headers of frame walls shall be insulated by completely filling the cavity with a material having a thermal resistance of R3 per inch minimum
- Exterior thermal envelope insulation for framed walls shall be installed in substantial contact and continuous alignment with the air barrier
1. Energy Compliance Path
2. Insulation materials and their R-values
4. Area-weighted U-factor and solar heat gain coefficients (SHGC) calculations.
5. Mechanical system design criteria.
6. Mechanical and service water-heating systems and equipment types, sizes and efficiencies.
7. Equipment and system controls.
8. Duct sealing, duct and pipe insulation and location.

R103.2.1 – Define the Thermal Envelope

### DEFINED BY IECC

**U-FACTOR**

The coefficient of heat transmission (air to air) through a building component or assembly, equal to the time rate of heat flow per unit area and unit temperature difference between the warm side and cold side air films (Btu/h • ft² • °F) [W/(m² • K)].

**SOLAR HEAT GAIN COEFFICIENT (SHGC)**

The ratio of the solar heat gain entering the space through the fenestration assembly to the incident solar radiation. Solar heat gain includes directly transmitted solar heat and absorbed solar radiation, that is then reradiated, conducted or convected into the space.

### TABLE R402.1.3 INSULATION MINIMUM R-VALUES AND FENESTRATION REQUIREMENTS BY COMPONENT

<table>
<thead>
<tr>
<th>CLIMATE ZONE</th>
<th>FENESTRATION U-FACTOR</th>
<th>SKYLIGHT U-FACTOR</th>
<th>GLAZED FENESTRATION SHGC</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>NR</td>
<td>0.75</td>
<td>0.25</td>
</tr>
<tr>
<td>1</td>
<td>NR</td>
<td>0.75</td>
<td>0.25</td>
</tr>
<tr>
<td>2</td>
<td>0.40</td>
<td>0.65</td>
<td>0.25</td>
</tr>
<tr>
<td>3</td>
<td>0.30</td>
<td>0.55</td>
<td>0.25</td>
</tr>
<tr>
<td>4 except Marine</td>
<td>0.30</td>
<td>0.55</td>
<td>0.40</td>
</tr>
<tr>
<td>5 and Marine</td>
<td>0.30</td>
<td>0.55</td>
<td>0.40</td>
</tr>
<tr>
<td>6</td>
<td>0.30</td>
<td>0.55</td>
<td>NR</td>
</tr>
<tr>
<td>7 and 8</td>
<td>0.30</td>
<td>0.55</td>
<td>NR</td>
</tr>
</tbody>
</table>

b. The fenestration U-factor column excludes skylights. The SHGC column applies to all glazed fenestration.

**Exception:** In Climate Zones 0 through 3, skylights shall be permitted to be excluded from glazed fenestration SHGC requirements provided that the SHGC for such skylights does not exceed 0.30.

e. There are no SHGC requirements in the Marine Zone.
i. A maximum U-factor of 0.32 shall apply in Climate Zones 3 through 8 to vertical fenestration products installed in buildings located either:

1. Above 4,000 feet in elevation, or

2. In windborne debris regions where protection of openings is required by Section R301.2.1.2 of the International Residential Code.

**Solar Heat Gain Coefficient**

Clear Glass SHGC: 0.86
Lower the number better the SHGC

86%
1. Energy Compliance Path
2. Insulation materials and their R-values
3. Fenestration U-factors and solar heat gain coefficients (SHGC)
4. Area-weighted U-factor and solar heat gain coefficients (SHGC) calculations
5. Mechanical system design criteria
6. Mechanical and service water-heating systems and equipment types, sizes and efficiencies
7. Equipment and system controls
8. Duct sealing, duct and pipe insulation and location
9. Air sealing details

R103.2.1 – Define the Thermal Envelope
• R402.3.1 – U-Factor
  • Area weighted average
• R402.3.2 – Glazed Fenestration SHGC
  • Area weighted average
  • Dynamic Glazing

R402.3.3 Glazed fenestration exemption.
Not greater than 15 square feet of glazed fenestration per dwelling unit shall be exempt from the U-factor and SHGC requirements in Section R402.1.2. This exemption shall not apply to the Total UA alternative in Section R402.1.5.

R402.3.4 Opaque door exemption.
One side-hinged opaque door assembly not greater than 24 square feet in area shall be exempt from the U-factor requirement in Section R402.1.2. This exemption shall not apply to the Total UA alternative.

Example of calculation used for submittal

<table>
<thead>
<tr>
<th>Item</th>
<th>#1 Value</th>
<th>#1 Area</th>
<th>#2 Value</th>
<th>#2 Area</th>
<th>#3 Value</th>
<th>#3 Area</th>
<th>#4 Value</th>
<th>#4 Area</th>
<th>Total Area Sq Ft</th>
<th>Weighted Average Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Window U-Value</td>
<td>0.32</td>
<td>x</td>
<td>59.5</td>
<td>+</td>
<td>0.3</td>
<td>x</td>
<td>45</td>
<td>+</td>
<td>0.29</td>
<td>x</td>
</tr>
</tbody>
</table>

(.32 x 59.5) + (.3 x 45) + (.29 x 219) + (.28 x 187.5) + 511 = .29
19.04 + 13.5 + 63.51 + 52.5 / 511 = .29

1. Energy Compliance Path✓
2. Insulation materials and their R-values✓
4. Area-weighted U-factor and solar heat gain coefficients (SHGC) calculations✓
5. Mechanical system design criteria.
6. Mechanical and service water-heating systems and equipment types, sizes and efficiencies.
7. Equipment and system controls.
8. Duct sealing, duct and pipe insulation and location.

R103.2.1 – Define the Thermal Envelope✓

CONTROLLING THERMAL FLOW

Most insulation is NOT an air barrier

Resists
Conduction

Does not resist Air Flow:
That is the job of the air barrier

* An Air Barrier is any solid material that blocks air flow including sealing at edges and seams

What is the biggest insulation Myth:
Insulation Stops the movement of air!
Insulation

Insulation traps pockets of air

Stagnate Air Pockets create the R-value

Air Barrier

Stopping the movement of air from scrubbing away the stagnate air pocket

Now it works

**WOULD I ACCEPT THESE?**

1. Rim joints junction.
   - $2^\circ$ closed cell spray foam and R12 batt insulation
   - All windows and doors will be framed with a closed cell spray foam

2. Attic access openings.
   - rigid insulation will be attached to the top side of the attic access panel for an R-38
Table R402.4.1.1 AIR BARRIER, AIR SEALING AND INSULATION INSTALLATION

General requirements A continuous air barrier shall be installed in the building envelope.
- Breaks or joints in the air barrier shall be sealed.
- Air-permeable insulation shall not be used as a sealing material.

18. Durably seal thermal envelope to limit air infiltration. The following shall be caulked, gasketed, weatherstripped, or otherwise sealed with an air barrier material, suitable film, or solid material:
   a. All joints, seams, and penetrations. Any breaks or joints in the air barrier shall be sealed.

A PICTURE IS WORTH A THOUSAND WORDS

- Plans examiners can verify the requirement is demonstrated on the plans.
- Builders understand how to build the component to comply with the code and how the architect designed the building.
- Inspectors have a tool to aid in enforcing the requirements.
Table R402.4.1.1 AIR BARRIER, AIR SEALING AND INSULATION INSTALLATION

Ceiling/attic
- The air barrier in any dropped ceiling or soffit shall be aligned with the insulation and any gaps in the air barrier shall be sealed.
- Access openings, drop down stairs or knee wall doors to unconditioned attic spaces shall be sealed.
Walls -
- The junction of the foundation and sill plate shall be sealed.
- The junction of the top plate and the top of exterior walls shall be sealed.
- Knee walls shall be sealed.

Table R402.4.1.1 AIR BARRIER, AIR SEALING AND INSULATION INSTALLATION
Windows, skylights and doors –
- The space between framing and skylights, and the jambs of windows and doors, shall be sealed.
Rim joists -
• Rim joists shall include the air barrier.
• The junctions of the rim board to the sill plate and the rim board and the subfloor shall be air sealed.

Table R402.4.1.1 AIR BARRIER, AIR SEALING AND INSULATION INSTALLATION
Floors, including cantilevered floors and floors above garages
• The air barrier shall be installed at any exposed edge of insulation.

Basement, Crawl space walls, and Slab Foundations -
• Exposed earth in unvented crawl spaces shall be covered with a Class I vapor retarder/air barrier in accordance with Section R402.2.10.
• Penetrations through concrete foundation walls and slabs shall be air sealed.
• Class 1 vapor retarders shall not be used as an air barrier on below-grade walls and shall be installed in accordance with Section R702.7 of the International Residential Code.
Shafts, penetrations -
- Duct and flue shafts to exterior or unconditioned space shall be sealed.
- Utility penetrations of the air barrier shall be caulked, gasketed or otherwise sealed and shall allow for expansion, contraction of materials and mechanical vibration.

Table R402.4.1.1 AIR BARRIER, AIR SEALING AND INSULATION INSTALLATION
Narrow cavities -
• Narrow cavities of 1 inch or less that are not able to be insulated shall be air sealed.

Garage separation –
• Air sealing shall be provided between the garage and conditioned spaces.
Table R402.4.1 AI R BEA RY, AIR SEALING AND INSULATION INSTALLATION

**Recessed lighting** -
- Recessed light fixtures installed in the building thermal envelope shall be air sealed in accordance with Section R402.4.5.
Plumbing, wiring, or other obstructions - cavities -

- All holes created by wiring, plumbing or other obstructions in the air barrier assembly shall be air sealed.

Shower/tub on exterior wall

- The air barrier installed at exterior walls adjacent to showers and tubs shall separate the wall from the shower or tub.
Electrical/phone box on exterior walls –
- The air barrier shall be installed behind electrical and communication boxes. Alternatively, air-sealed boxes shall be installed.

HVAC register boots –
- HVAC supply and return register boots that penetrate the building thermal envelope shall be sealed to the subfloor, wall covering or ceiling penetrated by the boot.
Where 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.
NEW TESTING REQUIREMENTS – Not so new

Leakage Rate R402.4.1.3
• Maximum leakage rate set at 5.0 Climate Zones 0-2
• Maximum leakage rate set at 3.0 Climate Zones 3-8

Testing R402.4.1.2
• New metric was introduced (By way of exception in R402.4.1.3)
  • CFM/SQ FT
  • Multifamily and SF ≤ 1,500 sq ft

1. Energy Compliance Path
2. Insulation materials and their R-values.
4. Area-weighted U-factor and solar heat gain coefficients (SHGC) calculations.
5. Mechanical system design criteria.
6. Mechanical and service water-heating systems and equipment types, sizes and efficiencies.
7. Equipment and system controls.
8. Duct sealing, duct and pipe insulation and location.

R103.2.1 – Define the Thermal Envelope

Controls R403.1 & Programable thermostat R403.1.1
• A minimum of one thermostat shall be provide for each separate heating and cooling system
• The thermostat controlling the primary heating or cooling system of the dwelling unit shall be capable of controlling the heating and cooling system on a daily schedule to maintain different temperature set points at different times of day and different days of the week. This thermostat shall include the capability to set back or temporarily operate the system to maintain zone temperatures of not less than 55°F (13°C) to not greater than 85°F (29°C).

The thermostat shall be programmed initially by the manufacturer with a heating temperature setpoint of not greater than 70°F (21°C) and a cooling temperature setpoint of not less than 78°F (26°C).
R403.3 Ducts.
Not to be confused with chickens

Ducts located outside conditioned space R403.3.1
Supply and Return outside conditioned space
R-8 for ducts 3" or greater
R-6 for ducts smaller than 3"

Ducts buried under building
PER THIS SECTION OR EQUIVALENT THERMAL DISTRIBUTION EFFICIENCY

Underground ducts
THERMAL DISTRIBUTION EFFICIENCY METHOD

R403.3.2 DUCTS LOCATED IN CONDITIONED SPACE.
For ductwork to be considered inside a conditioned space, it shall comply with one of the following:
1. The duct system shall be located completely within the continuous air barrier and within the building thermal envelope.

Ductwork in ventilated attic spaces shall be buried within ceiling insulation in accordance with Section R403.3.3 and all of the following conditions shall exist:
2.1 The air handler is located completely within the continuous air barrier and within the building thermal envelope.
2.2 The duct leakage, as measured either by a rough-in test of the ducts or a post-construction total system leakage test to outside the building thermal envelope in accordance with Section R403.3.6, is less than or equal to 1.5 cubic feet per minute (42.5 L/min) per 100 square feet of conditioned floor area served by the duct system.
2.3 The ceiling insulation R-value installed against and above the insulated duct is greater than or equal to the proposed ceiling insulation R-value, less the R-value of the insulation on the duct.
Ductwork in floor cavities located over unconditioned space shall comply with all of the following:

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

Insulation below duct must have a minimum of an R-19 that separate the duct from the unconditioned space.

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

1. A continuous air barrier installed between unconditioned space and the duct.
2. Minimum R-10 insulation installed in the cavity width separating the duct from the outside sheathing.
3. The remainder of the cavity insulation shall be fully insulated to the drywall side.

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

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

Minimum R-8 supply and return duct insulation.
3. In Climate Zones 1A, 2A and 3A, the supply ducts shall be completely buried within ceiling insulation, insulated to an R-value of not less than R-13 and in compliance with the vapor retarder requirements of Section M1601.4.6

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

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

Rough-in test:
With air handler total leakage shall be less than or equal to 4.0 cubic feet per minute per 100 square feet of conditioned floor area.
Without air handler installed at the time of the test, the total leakage shall be less than or equal to 3.0 cubic feet per minute per 100 square feet of conditioned floor area.

Postconstruction test:
Total leakage shall be less than or equal to 4.0 cubic feet per minute per 100 square feet of conditioned floor area.

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 per 100 square feet of conditioned floor area.

R403.6 Mechanical ventilation
Automatic or Gravity damper
Mechanical ventilation testing

R403.6.3 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.
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 technologies.
R403.4 Mechanical system piping insulation (Mandatory).

Mechanical system piping capable of carrying fluids greater than 105°F or less than 55°F shall be insulated to an R-3 minimum.

R403.4.1 Protection of piping insulation

Piping insulation exposed to weather shall be protected from damage including that caused by sunlight, moisture, equipment, maintenance, and wind and shall provide shielding from solar radiation that can cause degradation of the material. Adhesive tape shall not be permitted.

R403.5.1.1 Circulation systems 2021

- Provide circulation pump
- Dedicated return pipe or cold water supply
- Gravity and thermosyphon systems prohibited
- Controls to start pump on demand for hot water
- Controls to shut off pump when loop at temp and when there is no demand for hot water
- Controls to limit temperature not greater than 104°F
Insulation for service hot water piping with a thermal resistance, R-value, of not less than R-3 shall be applied to the following:

1. Piping 3/4 inch (19.1 mm) and larger in nominal diameter located inside the conditioned space.
2. Piping serving more than one dwelling unit.
3. Piping located outside the conditioned space.
4. Piping from the water heater to a distribution manifold.
5. Piping located under a floor slab.
7. Supply and return piping in circulation and recirculation systems other than cold water pipe return demand recirculation systems.

Snow and Ice Melt System Controls R403.9 (Mandatory)

- Auto controls to shut system off when surface temperature is above 50˚ and no precipitation falling, and outdoor temperature is above 40˚.

Don’t Forget Pools and Spas Have Requirements Too

- Heaters
- Timeswitches
- Covers
- Standards

IECC

1. Energy Compliance Path
2. Insulation materials and their R-values
3. Fenestration U-factors and solar heat gain coefficients (SHGC)
4. Area-weighted U-factor and solar heat gain coefficients (SHGC) calculations
5. Mechanical system design criteria
6. Mechanical and service water-heating systems and equipment types, sizes and efficiencies
7. Equipment and system controls
8. Duct sealing, duct and pipe insulation and location
9. Air sealing details

R103.2.1 – Define the Thermal Envelope
R404.1.1 Exterior lighting.

Connected exterior lighting for residential buildings shall comply with Section C405.5.

Exceptions:
1. Detached one- and two-family dwellings.
2. Townhouses.
3. Solar-powered lamps not connected to any electrical service.
4. Luminaires controlled by a motion sensor.
5. Lamps and luminaires that comply with Section R404.1.

R404.2 Interior lighting controls

Permanently installed lighting fixtures shall be controlled with either a dimmer, an occupant sensor control or other control that is installed or built into the fixture.

Exception: Lighting controls shall not be required for the following:
1. Bathrooms.
2. Hallways.
3. Exterior lighting fixtures.
4. Lighting designed for safety or security.
**Occupancy Sensors**

**OCCUPANT SENSOR CONTROL.** An automatic control device that detects the presence or absence of people within an area and causes lighting, equipment or appliances to be regulated accordingly.

**Dimmers**

**DIMMER.** A control device that is capable of continuously varying the light output and energy use of light sources.

**R404.3 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:

1. Lighting shall be controlled by a manual on and off switch which permits automatic shut-off actions.

   **Exception:** Lighting serving multiple dwelling units.

2. Lighting shall be automatically shut off when daylight is present and satisfies the lighting needs.

3. Controls that override automatic shut-off actions shall not be allowed unless the override automatically returns automatic control to its normal operation within 24 hours.
ALL COMPLIANCE PATHS MUST COMPLY WITH ONE OF THE FOLLOWING:

**R408.2.1 Enhanced envelope performance option**

≤ 95% of total UA

HOW TO COMPLY

R408.2.1 Enhanced envelope performance option

- This one may be difficult
  - The values in the tables are more efficient than in the past
  - Inspectors will need to verify all the insulation is installed correctly
    - Correct R-value
    - Correct Material
    - Installed per Manufacturer Installation Instructions
  - Verify U-factor and SHGC of all fenestration
  - Inspect air barriers
ALL COMPLIANCE PATHS MUST COMPLY WITH ONE OF THE FOLLOWING:

- R408.2.2 More efficient HVAC equipment performance option
  - 1. Greater than or equal to 95 AFUE natural gas furnace and 16 SEER air conditioner.
  - 2. Greater than or equal to 10 HSPF/16 SEER air source heat pump.
  - 3. Greater than or equal to 3.5 COP ground source heat pump.

R408.2.1 Enhanced envelope performance option
- Many builders are using higher efficient equipment
- Would be required if not fully electric
- Should be verified from Manual J/S and REScheck or the plans

R408.2.3 Reduced energy use in service water-heating option
1. Greater than or equal to 82 EF fossil fuel service water-heating system.
2. Greater than or equal to 2.0 EF electric service water-heating system.
3. Greater than or equal to 0.4 solar fraction solar water-heating system.
R408.2.1 Enhanced envelope performance option
R408.2.2 More efficient HVAC equipment performance option
R408.2.3 Reduced energy use in service water-heating option
  • Mindful of the efficiency of the equipment
  • Would be required if not fully electric
  • Should be verified from REScheck or the plans

ALL COMPLIANCE PATHS MUST COMPLY WITH ONE OF THE FOLLOWING:

R408.2.4 More efficient duct thermal distribution system option
1. 100 percent of ducts and air handlers located entirely within the building thermal envelope.
2. 100 percent of ductless thermal distribution system or hydronic thermal distribution system located completely inside the building thermal envelope.
3. 100 percent of duct thermal distribution system located in conditioned space as defined by Section R403.3.2.
R408.2.1 Enhanced envelope performance option
R408.2.2 More efficient HVAC equipment performance option
R408.2.3 Reduced energy use in service water-heating option
R408.2.4 More efficient duct thermal distribution system option
R408.2.5 Improved Air Sealing And Efficient Ventilation System option

• HRV/ERV can serve multi-requirements
• Verify the blower door test results less than 3 ACH
• Verify HRV/ERV
  • 75% sensible recovery efficiency SRE
  • No recirculation defront
  • ERV greater than 50% LRMT

HOW TO COMPLY

R401.2.5 Additional energy efficiency.

• 2.2. The proposed design of the building under Section R405.3 shall have an annual energy cost that is less than or equal to 95 percent of the annual energy cost of the standard reference design.

• 3. For buildings complying with the Energy Rating Index alternative Section R401.2.3, the Energy Rating Index value shall be at least 5 percent less than the Energy Rating Index target specified in Table R406.5.

<table>
<thead>
<tr>
<th>CLIMATE ZONE</th>
<th>ENERGY RATING INDEX</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>55</td>
</tr>
</tbody>
</table>

5% better then 55 is 52.25

ADDITIONAL EFFICIENCY PACKAGE

TOTAL BUILDING PERFORMANCE

• Do One Additional Efficiency Package Without Including In Proposed Design - Or
• 95% Annual Energy Cost

ENERGY RATING INDEX

• ERI Number Is 5% Less Than What’s In Table R406.5

R401.3 Certificate.

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. Where 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 ceilings, roofs, walls, foundation components such as slabs, basement walls, crawl space walls and floors and ducts outside conditioned spaces.

2. U-factors of fenestration and the solar heat gain coefficient (SHGC) of fenestration. Where there is more than one value for any component of the building envelope, the certificate shall indicate both the value covering the largest area and the area weighted average value if available.

3. The results from any required duct system and building envelope air leakage testing performed on the building.

4. The types, sizes and efficiencies of heating, cooling and service water-heating equipment. Where a gas-fired unvented room heater, electric furnace or baseboard electric heater is installed in the residence, the certificate shall indicate “gas-fired unvented room heater,” “electric furnace” or “baseboard electric heater,” as appropriate. An efficiency shall not be indicated for gas-fired unvented room heaters, electric furnaces and electric baseboard heaters.

5. Where on-site photovoltaic panel systems have been installed, the array capacity, inverter efficiency, panel tilt and orientation shall be noted on the certificate.

6. For buildings where an Energy Rating Index score is determined in accordance with Section R406, the Energy Rating Index score, both with and without any on-site generation, shall be listed on the certificate.

7. The code edition under which the structure was permitted, and the compliance path used.
LET'S PLAY A GAME

THANK YOU

Hope Medina, CSP, CBO
hope.medina@shumscoda.com