Edited & Presented by Donald Vigneau AIA
Additional Editing by Kevin Rose
WHAT DOES NEEP DO?

FACILITATE PARTNERSHIPS...

REGIONAL INITIATIVES
- High Efficiency Retail Products
- High Efficiency Home Performance
- High Efficiency Commercial Buildings and Technologies
- Workforce Development

PUBLIC POLICY
- Policy Outreach
- **Building Energy Codes**
- High Performance School and Public Buildings
- Appliance Efficiency Standards

EM&V FORUM
- Protocol Development
- Research and Evaluation
- Education and Information Access

NEEP SUMMIT
- Conference
- Workshop
- Business Leadership
- Exhibition

TO ADVANCE THE EFFICIENT USE OF ENERGY EFFICIENCY
IECC addresses only energy. 2012 has format change: from Chapter 4 to 4[RE]; 5 to 5[CE]

IRC addresses all topics (structural, plumbing, etc.)

- Allows builder to carry only one code book

In 2012, consolidated with IRC energy chapter (actually a change to the IRC, not the IECC)

- Chapter 11 duplicates RE; covers energy efficiency

IECC addresses both residential and commercial;

IRC addresses subset of residential:
detached one- and two-family dwellings and attached townhouses 3 stories or under
Scoping unchanged except INTENT: “Useful life of each building”

- Code applies to any new construction
- Unaltered portion(s) do not need to comply
- Additions can comply alone or in combination with existing building
- Replacement fenestration that includes both glazing and sash must meet R402.3.6:
  - 0.40 SHGC in Climate Zone 4
  - U-factors in Climate Zones 4
- Exceptions UNCHNGED
• New requirements added
  – Building envelope air leakage testing \( (R402.4.1.1 + \ DE \ mods) \)
  – Duct leakage sealing methods \( (R403.2.2 + \ DE \ mods) \)
  – Whole-house mechanical ventilation \( (R403.5 + \ DE \ mods) \)
  – Pool heaters; uninsulated covers \( (R403.9) \)
  – Lighting efficacy becomes 75% of fixtures \( (R404.1) \)

• Moisture control requirements (vapor retarders) revised; 2009 moved to IRC R601.3 (Table + 5 other sections)

• Changes have a bar \( | \) at the margin to clue you in
• 6 new Definitions: *skylight* changed to match 90.1 (60°)

• More thermal envelope improvements – Table 402.2.1

• No mechanical trade-offs for Performance R-values

• Performance path glazing/leakage changed (T405.5.2[1])
ENVELOPE: Control Priorities

- WATER
- AIR
- WATER VAPOR
- THERMAL

www.buildingscience.com
WATER CONTROL DETAILS

SIDING/CLADDING

“ALL SIDINGS LEAK”

- Ventilate
- Protect drainage plane
- Avoid dams against TYVEK

DRAINAGE PLANES

- Flash all transitions
- Maintain continuity
- Let gravity do the work
- Eliminate dams (or protect siding)
- Manage at ground level
• **Eliminate** interior layer vapor retarder

• **Seal** joints/seams at the sheathing membrane from foundation to ridge

• **Use** c.i. insulation outside, cavity insulation inside

• **Air tested** leakage < 20% of conventional home

• **Requires** HRV ventilation for heating/cooling seasons

**www.buildingscience.com**
• Use of “outsulation” puts the air / vapor barrier plane at wall and roof sheathing lines; keeping the rigid insulation board outside the plane of the foundation. Note where window unit is set.
Vapor retarder requirements allow the use of a coat of alkyd paint to satisfy the requirement in Zone 4 when:

• An impermeable insulating sheathing with a minimum value of R-5 is located outside of a 2x4 stud wall with cavities insulated to R-3.4 per inch (R-11);

• An impermeable insulating sheathing with a minimum value of R-7.5 is located outside of a 2x6 stud wall with cavities insulated to R-3.4 per inch (R-18.7);
Prescriptive (Climate-Specific) Requirements:

- Roofs
- Above grade walls
- Foundations
  - Basements
  - Slabs
  - Crawlspace
- Skylights, windows, and doors
- Solar Heat Gain Coefficient (SHGC) **NOW IN DELAWARE**

Mandatory Requirements *(apply everywhere)*:

- Infiltration control
- Duct insulation, sealing, and testing
- HVAC / **SWH controls**
- Piping Insulation
- Equipment sizing
- Dampers
- Lighting
IECC Compliance - Three Options

1. **PRESCRIPTIVE**
   - Insulation & Fenestration Only
     - R402.1.1

2. **U-FACTOR & “UA” ALTERNATIVES**
   - U-factor
     - R402.1.3
     - Total Building UA
     - R402.1.4

3. **SIMULATED PERFORMANCE (software)**
   - Simulated Performance Alternative
     - R405
IECC Terminology

☑ Prescriptive – R-value or U-factor; SHGC
  • Required choices based upon zone, construction type

☑ UA Alternative
  • Required performance; can be modified by trading for compensating envelope improvements elsewhere

☑ Mandatory
  • Required; cannot be traded down, even in the Simulated Performance Path

Some elements have “hard limits” a/k/a “trade-off limits”

☑ prescriptive requirement can only be reduced so far
☑ performance requirements can only be reduced so far
Code Compliance Tools

- **Prescriptive**: None Needed
- **Total Building UA Trade-Off**: REScheck Software (Web-based & Desktop)
- **Energy Analysis**: Software (example) REM/Design REM/Rate EnergyGauge
CONTROLLING FENESTRATION

- WINDOWS
- SKYLIGHTS*
- DOORS*
✓ Meet U-factors

✓ **Meet SHGC: 0.40**

✓ Skylight is now $< 60^0$ from horizontal
### U-Factors and SHGC

<table>
<thead>
<tr>
<th>Rating</th>
<th>Description</th>
<th>Value 1</th>
<th>Value 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>NFRC 100</td>
<td>U-Factor (U.S./I-P)</td>
<td>0.35</td>
<td>0.32</td>
</tr>
<tr>
<td></td>
<td>Solar Heat Gain Coefficient</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Visible Transmittance</td>
<td>0.51</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Air Leakage (U.S./I-P)</td>
<td>0.2</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Condensation Resistance</td>
<td>51</td>
<td></td>
</tr>
</tbody>
</table>

**NOT REQUIRED**

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**NFRC 200**

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**NFRC 400**

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U.S. DEPARTMENT OF ENERGY

Energy Efficiency & Renewable Energy

www.energycodes.gov/training
Ceilings

Requirements based on

- Assembly type
- Continuous insulation
- Insulation between framing (cavity insulation)

Meet or exceed R-values

- **R-49 is the NEW value for Zone 4**
### Table R402.1.1

**Insulation 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>
<th>Ceiling R-Value</th>
<th>Wood Frame Wall R-Value</th>
<th>Mass Wall R-Value</th>
<th>Floor R-Value</th>
<th>Basement Wall R-Value</th>
<th>Slab R-Value &amp; Depth</th>
<th>Crawlspace Wall R-Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>NR</td>
<td>0.75</td>
<td>0.25</td>
<td>30</td>
<td>13</td>
<td>3/4</td>
<td>13</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>2</td>
<td>0.40</td>
<td>0.65</td>
<td>0.25</td>
<td>38</td>
<td>13</td>
<td>4/6</td>
<td>13</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>3</td>
<td>0.35</td>
<td>0.55</td>
<td>0.25</td>
<td>38</td>
<td>20 or 13+5h</td>
<td>8/13</td>
<td>19</td>
<td>5/13</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>4 except</td>
<td>0.35</td>
<td>0.55</td>
<td>0.40</td>
<td>49</td>
<td>20 or 13+5h</td>
<td>8/13</td>
<td>19</td>
<td>10/13</td>
<td>10, 2 ft</td>
<td>10/13</td>
</tr>
<tr>
<td>Marine</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5 and</td>
<td>0.32</td>
<td>0.55</td>
<td>NR</td>
<td>49</td>
<td>20 or 13+5h</td>
<td>13/17</td>
<td>30</td>
<td>15/19</td>
<td>10, 2 ft</td>
<td>15/19</td>
</tr>
<tr>
<td>Marine 4</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>0.32</td>
<td>0.55</td>
<td>NR</td>
<td>49</td>
<td>20+5 or 13+10h</td>
<td>15/20</td>
<td>30</td>
<td>15/19</td>
<td>10, 4 ft</td>
<td>15/19</td>
</tr>
<tr>
<td>7 and 8</td>
<td>0.32</td>
<td>0.55</td>
<td>NR</td>
<td>49</td>
<td>20+5 or 13+10h</td>
<td>19/21</td>
<td>38</td>
<td>15/19</td>
<td>10, 4 ft</td>
<td>15/19</td>
</tr>
</tbody>
</table>

**For SI:** 1 foot = 0.3048 mm.

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

- **b.** The fenestration U-factor column excludes skylights. The SHGC column applies to all glazed fenestration. Exception: Skylights may be excluded from glazed fenestration SHGC requirements in Climate Zones 1 through 3 where the SHGC for such skylights does not exceed 0.30.

- **c.** “15/19” means R-15 continuous insulation on the interior or exterior of the home or R-19 cavity insulation at the interior of the basement wall. “15/19” shall be permitted to be met with R-13 cavity insulation on the interior of the basement wall plus R-5 continuous insulation on the interior or exterior of the home. “10/13” means R-10 continuous insulation on the interior or exterior of the home or R-13 cavity insulation on the interior of the basement wall.

- **d.** R-5 shall be added to the required slab edge R-values for heated slabs. Insulation depth shall be the depth of the footing or 2 feet, whichever is less in Climate Zones 1 through 3 for heated slabs.

- **e.** There are no SHGC requirements in the Marine Zone.

- **f.** Basement wall insulation is not required in warm-humid locations as defined by Figs. 1-201.1 and Table R301.1.

- **g.** Or insulation sufficient to fill the framing cavity, R-19 minimum.

- **h.** First value is cavity insulation, second is continuous insulation or insulated siding, so “13+5” means R-13 cavity insulation plus R-5 continuous insulation or insulated siding. If structural sheathing covers 40 percent or less of the exterior, continuous insulation R-value shall be permitted to be reduced by no more than R-3 in the locations where structural sheathing is used – to maintain a consistent total sheathing thickness.

- **i.** The second R-value applies when more than half the insulation is on the interior of the mass wall.
Prescriptive R-value path encourages raised heel truss *(aka, energy truss)*

✓ If insulation is full height over exterior wall top plate
  - R-30 complies where R-38 is required
  - R-38 complies where R-49 is required

*Note: This reduction ONLY applies to the R-value prescriptive path, not the U-factor or Total UA alternatives*
✓ R-30 allowed for 500 ft\(^2\) or 20% total insulated ceiling area, whichever is less, where

✓ Required Insulation levels are > R-30
✓ Insufficient space available to accommodate higher levels

✓ However; Table R402.1.1 Note “a” does not allow a batt insulation with a face value of R-30 to be squeezed into a too shallow cavity (2x8); it requires a minimum cavity depth of at least 2x10 (9-1/4”), or a combination of batt + continuous insulation

Note: This reduction ONLY applies to the R-value prescriptive path, not the U-factor or Total UA alternatives
Steel-Frame Ceilings
Section R402.2.6

✓ “R-X + Y” means R-X cavity plus R-Y continuous
✓ In ceilings, insulation that exceeds the height of the framing must cover the framing

Table keys on the wood-frame requirement for the corresponding building component

---

<table>
<thead>
<tr>
<th>Wood Frame R-value Requirement</th>
<th>Cold-Formed Steel Equivalent R-value&lt;sup&gt;a&lt;/sup&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Steel Truss Ceilings&lt;sup&gt;b&lt;/sup&gt;</td>
<td></td>
</tr>
<tr>
<td>R-30</td>
<td>R-38 or R-30 + 3 or R-26 + 5</td>
</tr>
<tr>
<td>R-38</td>
<td>R-49 or R-38 + 3</td>
</tr>
<tr>
<td>R-49</td>
<td>R-38 + 5</td>
</tr>
<tr>
<td>Steel Joist Ceilings&lt;sup&gt;b&lt;/sup&gt;</td>
<td></td>
</tr>
<tr>
<td>R-30</td>
<td>R-38 in 2x4, or 2x6, or 2x8</td>
</tr>
<tr>
<td></td>
<td>R-49 any framing</td>
</tr>
<tr>
<td>R-38</td>
<td>R-49 2x4, or 2x6, or 2x8, or 2x10</td>
</tr>
<tr>
<td>Steel Framed Wall</td>
<td></td>
</tr>
<tr>
<td>R-13</td>
<td>R-13 + 4.2 or R-19 +2.1, or R-21 +2.8 or R-0+9.3 or R-15+R-3.8 or R-21 + 3.1</td>
</tr>
<tr>
<td>R-13+R-3</td>
<td>R-0 + 11.2 or R-13 +6.1, or R-15 +5.7 or R-19+5.0 or R-21+4.7</td>
</tr>
</tbody>
</table>
Wood-Frame Walls
Section R402

Table R402.1.1
INSULATION AND FENESTRATION REQUIREMENTS BY COMPONENT

<table>
<thead>
<tr>
<th>CLIMATE ZONE</th>
<th>FENESTRATION U-FACTOR&lt;sup&gt;b&lt;/sup&gt;</th>
<th>SKYLIGHT&lt;sup&gt;b&lt;/sup&gt; U-FACTOR</th>
<th>GLAZED FENESTRATION SHGC&lt;sup&gt;b, e&lt;/sup&gt;</th>
<th>CEILING R-VALUE</th>
<th>WOOD FRAME WALL R-VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>NR</td>
<td>0.75</td>
<td>0.25</td>
<td>30</td>
<td>13</td>
</tr>
<tr>
<td>2</td>
<td>0.40</td>
<td>0.65</td>
<td>0.25</td>
<td>38</td>
<td>13</td>
</tr>
<tr>
<td>3</td>
<td>0.35</td>
<td>0.55</td>
<td>0.25</td>
<td>38</td>
<td>20 or 13+5&lt;sup&gt;h&lt;/sup&gt;</td>
</tr>
<tr>
<td>4 except Marine</td>
<td>0.35</td>
<td>0.55</td>
<td>0.40</td>
<td>49</td>
<td>20 or 13+5&lt;sup&gt;h&lt;/sup&gt;</td>
</tr>
<tr>
<td>5 and Marine 4</td>
<td>0.32</td>
<td>0.55</td>
<td>NR</td>
<td>49</td>
<td>20 or 13+5&lt;sup&gt;h&lt;/sup&gt;</td>
</tr>
<tr>
<td>6</td>
<td>0.32</td>
<td>0.55</td>
<td>NR</td>
<td>49</td>
<td>20+5 or 13+10&lt;sup&gt;h&lt;/sup&gt;</td>
</tr>
<tr>
<td>7 and 8</td>
<td>0.32</td>
<td>0.55</td>
<td>NR</td>
<td>49</td>
<td>20+5 or 13+10&lt;sup&gt;h&lt;/sup&gt;</td>
</tr>
</tbody>
</table>

h. First value is cavity insulation, second is continuous insulation or insulated siding, so “13+5” means R-13 cavity insulation plus R-5 continuous insulation or insulated siding. If structural sheathing covers 40 percent or less of the exterior, continuous insulation R-value shall be permitted to be reduced by no more than R-3 in the locations where structural sheathing is used – to maintain a consistent total sheathing thickness.
# Mass Wall Requirements

**Section R402.2.5**

### Table R402.1.1

**INSULATION AND FENESTRATION REQUIREMENTS BY COMPONENT**

<table>
<thead>
<tr>
<th>CLIMATE ZONE</th>
<th>FENESTRATION U-FACTOR&lt;sup&gt;b&lt;/sup&gt;</th>
<th>SKYLIGHT&lt;sup&gt;b&lt;/sup&gt; U-FACTOR</th>
<th>GLAZED FENESTRATION SHGC&lt;sup&gt;b,e&lt;/sup&gt;</th>
<th>CEILING R-VALUE</th>
<th>WOOD FRAME WALL R-VALUE</th>
<th>MASS WALL R-VALUE&lt;sup&gt;i&lt;/sup&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>NR</td>
<td>0.75</td>
<td>0.25</td>
<td>30</td>
<td>13</td>
<td>3/4</td>
</tr>
<tr>
<td>2</td>
<td>0.40</td>
<td>0.65</td>
<td>0.25</td>
<td>38</td>
<td>13</td>
<td>4/6</td>
</tr>
<tr>
<td>3</td>
<td>0.35</td>
<td>0.55</td>
<td>0.25</td>
<td>38</td>
<td>20 or 13+5&lt;sup&gt;h&lt;/sup&gt;</td>
<td>8/13</td>
</tr>
<tr>
<td>4 except Marine</td>
<td>0.35</td>
<td>0.55</td>
<td>0.40</td>
<td>49</td>
<td>20 or 13+5&lt;sup&gt;h&lt;/sup&gt;</td>
<td>8/13</td>
</tr>
<tr>
<td>5 and Marine 4</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>20 or 13+5&lt;sup&gt;h&lt;/sup&gt;</td>
<td>13/17</td>
</tr>
<tr>
<td>6</td>
<td></td>
<td></td>
<td></td>
<td>0+5 or 13+10&lt;sup&gt;h&lt;/sup&gt;</td>
<td>15/20</td>
<td>10+5 or 13+10&lt;sup&gt;h&lt;/sup&gt;</td>
</tr>
<tr>
<td>7 and 8</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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Second (higher) number applies when more than half the R-value is on the interior of the mass (i.e., when the thermal mass is insulated from the conditioned space)
Sunroom Requirement Changes

- Ceiling Insulation  R-19
- Wall Insulation      R-13
- Fenestration        U-0.45
  - (0.50)
- Skylight            U-0.70
  - (0.75)
- SHGC (new)          0.40
Compliance must be by testing:

- Whole-house pressure test

<table>
<thead>
<tr>
<th>Air Leakage Rate</th>
<th>Climate Zone</th>
<th>Test Pressure</th>
</tr>
</thead>
<tbody>
<tr>
<td>≤ 5 ACH</td>
<td>1-2</td>
<td>50 Pascals</td>
</tr>
<tr>
<td>≤ 3 ACH*</td>
<td>3-8</td>
<td>50 Pascals</td>
</tr>
</tbody>
</table>

- Testing may occur at any time after creation of all building envelope penetrations*

- Table R402.4.1.1 must also be field verified

- Delaware Exceptions*
Delaware Exceptions: Dwelling units with 2,000 ft$^2$ or less of conditioned floor area (CFA) may satisfy R402.4.1.2 if they attain:

(1) a HERS Score of 69; and
(2) an air leakage rate per 100sf of not more than:
- 4 ACH 50/ for homes $\geq 1,500$ SF & $\leq 2,000$ SF
- 5 ACH 50 for homes $< 1,500$ SF

3 ACH 50 is still required for homes $> 2,000$ SF
### Fenestration

**Section R402.4.3 - Air Leakage**

<table>
<thead>
<tr>
<th>TYPE</th>
<th>AIR INFILTRATION RATE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Windows, sliding glass doors, and skylights</td>
<td>≤ 0.3 cfm/ft²</td>
</tr>
<tr>
<td>Swinging doors</td>
<td>≤ 0.5 cfm/ft²</td>
</tr>
</tbody>
</table>

**Exceptions**

- Site-built windows, skylights, and doors
Mandatory Requirements
Section R402.4 - Air Leakage

✓ Building thermal envelope (Section R402.4.1)
  ✓ Added Common Walls of Units
✓ Recessed lighting
✓ Fenestration
✓ Fireplaces
### A Combined Table - R402.4.1.1

<table>
<thead>
<tr>
<th>Component</th>
<th>Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>Air barrier and thermal barrier</td>
<td>A continuous air barrier shall be installed in the building envelope. Exterior thermal envelope contains a continuous air barrier. Breaks or joints in the air barrier shall be sealed. Air-permeable insulation shall not be used as a sealing material.</td>
</tr>
<tr>
<td>Ceiling/attic</td>
<td>The air barrier in any dropped ceiling/soffit shall be aligned with the insulation and any gaps in the air barrier sealed. Access openings, drop down stair or knee wall doors to unconditioned attic spaces shall be sealed.</td>
</tr>
<tr>
<td>Walls</td>
<td>Corners and headers shall be insulated and the junction of the foundation and sill plate shall be sealed. The junction of the top plate and top of exterior walls shall be sealed. Exterior thermal envelope insulation for framed walls shall be installed in substantial contact and continuous alignment with the air barrier. Knee walls shall be sealed.</td>
</tr>
<tr>
<td>Windows, skylights and doors</td>
<td>The space between window/door jambs and framing and skylights and framing shall be sealed.</td>
</tr>
<tr>
<td>Rim joists</td>
<td>Rim joists shall be insulated and include the air barrier.</td>
</tr>
<tr>
<td>Floors (including above-garage and cantilevered floors)</td>
<td>Insulation shall be installed to maintain permanent contact with underside of subfloor decking. The air barrier shall be installed at any exposed edge of insulation.</td>
</tr>
</tbody>
</table>

*(partial table)*
CONTROLLING VENTILATION

Core: Heat Recovery Units feature a lifetime warranty on the aluminum core.

Washable Electrostatic Filters

Superior EBM Motors: Units are designed with German manufactured EBM external rotor motorized impellers – the most durable motors in the industry. Precise balancing ensures vibration-free operation. No maintenance needed. 7 Year Limited Warranty.

Fully Insulated Cabinet: Baked powder-coat finish. Insulated with 1” (25mm) foil-faced, high density polystyrene foam. For quiet, trouble-free operation.

Electronic Control Board: Units feature state-of-the-art control boards for easy connection to existing HVAC equipment. All units are designed for easy operation from a series of optional remote controls.
R402.5. Hard limits on U-factor in northern U.S. (cannot exceed, even in trade-offs)

<table>
<thead>
<tr>
<th>Climate Zones</th>
<th>U-Factor Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>4-5</td>
<td>0.48</td>
</tr>
<tr>
<td>6-8</td>
<td>0.40</td>
</tr>
</tbody>
</table>

- U-0.35 for windows/doors
- U-factors of individual windows or skylights can be higher if maximum area-weighted average is ≤ these limits.
- U-0.55 for skylights
- SHGC – 0.40 (new)
Less stringent insulation R-value and glazing U-factor requirements

Sunroom definition:

- One story structure
- Glazing area >40% glazing of gross exterior wall and roof area
- Separate heating or cooling system or zone
- Must be thermally isolated (closeable doors / windows to the remainder of the house)
- Can always meet Table R402.1.1 requirements with unlimited glass
- No separate floor R-value (R19)
Sunroom Requirements
Section R402.2.12

- Ceiling Insulation
  - Zones 1-4  R-19

- Wall Insulation
  - All zones  R-13

- Fenestration U-Factor
  - Zones 4-8  0.45 (0.50)

- Skylight U-Factor
  - Zones 4-8  0.70 (0.75)
Mechanical Systems & Equipment

NAECA

Equipment efficiency set by Federal law, not the I-Codes
ACCA Standards

• J – Load Calculations
• S – Equipment Selections
• D – Duct Design (n/r)

“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”

Mandatory Requirements - *R403*
HVAC and SWH Systems

- Controls
- Heat pump supplementary heat
- Ducts
  - Sealing (Mandatory) – **post-construction test option**
  - Insulation (Prescriptive) - unchanged
- HVAC piping insulation
- Service hot water circulating systems
- Ventilation
  - Dampers
- Equipment sizing
- Multiple dwelling units: systems – **use CE 403 & 404? Or 90.1 Section 6.3?**
- Snow melt controls
- Pools and in-ground permanently installed spas
Sealing (Mandatory)

- Joints and seams to comply with either IMC or IRC
- All ducts, air handlers, and filter boxes to be sealed (Section R403.2.2)

Exceptions

- No additional joint seals required for air-impermeable spray foam products
- Where duct connection is partially inaccessible, 3 screws or rivets to be equally spaced on exposed portion of joint to prevent a hinge effect
- Continuously welded and locking-type longitudinal joints and seams in ducts operating at static pressures < 2 in. w.c. don’t require additional closure systems
Delaware modifications proposed:

✓ R-3 required on
  – HVAC systems (see DE list – 7 items)
    • Exception: Piping that conveys fluids between 55 and 105°F
  • If exposed to weather,
    – protect from damage, including
      • Sunlight
      • Moisture
      • Equipment maintenance
      • Wind
    – Provide shielding from solar radiation that can cause degradation of material
    – Adhesive tape is not allowed

• Exception: meet uninsulated run length requirements in Table R403.4.2
Ventilation

- Building to have ventilation meeting IRC or IMC or with other approved means
- Outdoor air intakes and exhausts shall have automatic or gravity dampers that close when the ventilation system is not operating

DNREC proposing 6 cfm/100sf for final or rough test

Whole-house mechanical ventilation system fans to meet efficacy in Table R403.5.1

Exception

- When fans are integral to tested and listed HVAC equipment, powered by electronically commutated motor
**Duct Tightness Tests**

**Section R403.2.2**

- **Rough-in test**
  - Total leakage $\leq 6$ cfm/100 ft$^2$ of conditioned floor area
    - if air handler not installed at time of test, total air leakage
      $\leq 3$ cfm/per 100 ft$^2$
  
  **Exception**: Test not required if air handler & all ducts are located in building thermal envelope

- **Post construction test**
  - Total leakage: $\leq 6$ cfm/per 100 ft$^2$ of conditioned floor area
    - including manufacturer’s air handler enclosure
  - All register boots taped or otherwise sealed
Framing cavities cannot be used as ducts or plenums (supply or return)

90.1-2010 allows for this in commercial construction
NEW - Air handlers to have manufacturer’s designation for an air leakage of ≤ 2% of design air flow rate per ASHRAE 193
All systems that serve multiple dwelling units shall comply with 90.1 Sections 6 and 7 in lieu of Section R403.

- Shutoff controls for snow- and ice-melting systems
  - Automatic when pavement temperature is > 50°F and no precipitation is falling
  - Automatic or manual when outdoor temperature is > 40°F
A minimum of **75 percent** of the **lamps** in permanently installed lighting fixtures shall be high-efficacy lamps, or **75 percent** of permanently installed **lighting fixtures** to contain only high efficacy lamps

**Exception:**

- Low-voltage lighting
✓ Glazing limited to 15%
  ▪ Includes conditioned basements
✓ Internal shading changes
✓ Air exchange = 3 ACH
  ▪ 3rd Party testing
✓ Air-source heat pump used as standard where resistance heating is proposed
RESCheck™ v4.4.4.3

Desktop Software Tools

Windows version or Mac version

Web-Based Tools

Free downloads!
Main Steps

1. Select the Appropriate Program and Code

2. Enter Project Information

3. Enter Building Components from “TOOLS”
   - FIRST: use Area Calc in Envelope tab under ‘Tools’
   - Calculate shapes in Area Calc with Shapes Calculator
   - WHEN DONE: Save data to Envelope tab entries
   - Drag & drop windows/doors into correct wall areas
Main Steps

4. Enter Mechanical Equipment (optional)

5. View/Print the Compliance Report
   4. Print checklist and certificate

6. Save the Data File and the Report
Appropriate Code

- Energy code applicable to your state/jurisdiction (Code Menu)
  - Status of State Codes
- Default
- Preferences
Project Information

- Project location
- Project type
- Building Area (ft$^2$)
- Project details for report (optional)
  - Title/Site/Permit
  - Owner/Agent
  - Designer/Contractor
  - Notes
Envelope Screen

- Changes based on code and/or location selected
  - SHGC column
  - Overhang P/F column
  - Orientation option
    - Front Faces ??
AREACALC TOOL

• REScheck tab bar
• Calculates building component areas and UA’s
• Library allows for saving windows, doors, skylights
• Areas can be transferred into REScheck (New button)
Screen Operations

Included in latest 2009 version
Building Components

- Only incorporate components that separate conditioned space from unconditioned space
- Only use applicable buttons
- Can group “like” components
- Use of “other” assembly type
- Gross area of components entered
  - Program deducts fenestration and calculates net area
Screen Operations

- Compliance Bar
- Status Bar
- Colors - Red: missing info, errors; failing
Screen Operations

- Compliance Bar
- Status Bar
- Colors – **Blue**: Looking for data input
  - **Green**: It passes (so far)
  - **Red**: Go back and look at your UA’s
Screen Operations

- Compliance Bar
- Status Bar
- Colors
- Right Mouse Button
  - “Context” Menu
### Compliance Report

- Project complies
- View/Print Report

## Project Information

## Building Components

## Compliance Statement

## Project Notes

### Compliance Certificate

- **Project Title:** North Meadows Development
- **Energy Code:** 2000 IECC
- **Location:** Greensboro, North Carolina
- **Construction Type:** Single Family
- **Heating Degree Days:** 5950
- **Construction Site:**
  - Permit Date: 3/17/00

#### Compliance Results

<table>
<thead>
<tr>
<th>Assembly</th>
<th>Gross Area or Perimeter</th>
<th>U Value</th>
<th>R Value</th>
<th>L Value</th>
<th>Glazing or Door U-Factor</th>
<th>UA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ceiling 1: Flat Ceiling or Slab Floor</td>
<td>750</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>23</td>
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<tr>
<td>Ceiling 2: Flat Ceiling or Slab Floor</td>
<td>592</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>23</td>
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<tr>
<td>Wall 1: Wood Frame, 10' o.c.</td>
<td>1647</td>
<td>7.0</td>
<td>6.0</td>
<td>6.0</td>
<td>34</td>
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<tr>
<td>Door 1: Glass</td>
<td>56</td>
<td>0.420</td>
<td>0.420</td>
<td>0.420</td>
<td>36</td>
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</tr>
<tr>
<td>Window 1: Vinyl Frame, Double Pane with Low-E</td>
<td>204</td>
<td>0.450</td>
<td>0.450</td>
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<td>36</td>
<td></td>
</tr>
<tr>
<td>Door 2: Solid</td>
<td>276</td>
<td>0.540</td>
<td>0.540</td>
<td>0.540</td>
<td>36</td>
<td></td>
</tr>
<tr>
<td>Wall 2: Wood Frame, 10' o.c.</td>
<td>16</td>
<td>0.350</td>
<td>0.350</td>
<td>0.350</td>
<td>36</td>
<td></td>
</tr>
<tr>
<td>Door 3: Solid</td>
<td>276</td>
<td>0.350</td>
<td>0.350</td>
<td>0.350</td>
<td>36</td>
<td></td>
</tr>
<tr>
<td>Floor 1: AllWood Joists/Timbers, Over Unconditioned Space</td>
<td>32</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>44</td>
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</tr>
<tr>
<td>Floor 2: AllWood Joists/Timbers, Over Inside Air</td>
<td>32</td>
<td>0.300</td>
<td>0.300</td>
<td>0.300</td>
<td>44</td>
<td></td>
</tr>
<tr>
<td>Roof 3: Slab-On-Grade Uninsulated</td>
<td>62</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>54</td>
<td></td>
</tr>
</tbody>
</table>

#### Compliance Statement

The proposed building design described here is consistent with the building plans, specifications, and other calculations submitted with the permit application. The proposed building has been designed to meet the 2000 IECC requirements in REScheck Version 4.2.0 and to comply with the mandatory requirements listed in the REScheck Inspection Checklist.

- **Name:**
- **Title:**
- **Signature:**
- **Date:**

#### Project Notes

- Previously saved project information:
  - 1010 Construction Ave.
  - Greensboro, North Carolina
  - Guilford County
  - Careful Builders, Inc.
  - 125 W. St.
  - Greensboro, NC 27411

---

**Report Date:** 02/01/00

**Report File:** C:\Program Files\CheckREScheck420\example.txt
Panel Certificate

- Under IECC 2009-based codes, panel certificate option
Score and Store is an application for gathering compliance checklists from states in an effort to gauge the 90% compliance effort.

Log in below to complete checklists for your state. If you don't have an account, you should contact linda.connell@pnl.gov.

Contact: Technical Support
Security & Privacy
Using the Evaluation Checklists

**Compliance Approaches**

- Prescriptive
- Trade-off
- Performance (IECC)
RESCheck uses these in Compliance Checklists (v.4.4.4)
SCORE + STORE METRICS

- Score + Store
- Sample Results

Checklist Metrics

Code Requirements with Highest Compliance Rate (Top 3)

PR6 - [3.4.1.1] Feeder connectors sized in accordance with approved plans.

PR7 - [3.4.1.2] Branch circuits sized for maximum drop of 3%.

ME8 - [6.4.4.1.2] HVAC ducts and plenums insulated.

Code Requirements with Lowest Compliance Rate (Top 3)

PR1 - [4.2.2] Plans and/or specifications provide all information with which compliance can be determined for the building envelope and delineate and document where exceptions to the standard are claimed.

FR3 - [5.4.3.2] Fenestration and doors labeled for air leakage.

FR2 - [5.4.3.2] Doors meet maximum air leakage requirements.

Code Requirements Most Frequently Not Observed (Top 3)

FR14 - [5.8.2.3, 5.5.3.6] U-factor of opaque doors associated with the building thermal envelope meets requirements.

FR12 - [5.8.2.1] Fenestration products rated in accordance with NFRC.

FR13 - [5.8.2.2] Fenestration products are certified as to performance labels or certificates provided.

Compliance Approach Breakdown

- Trade-Off (9%)
- Performance (5%)
- Prescriptive (86%)
- Climate Specific: CT – Zone 5
- Support for all compliance approaches
  - Prescriptive
  - Trade-Off
  - Performance
- Evaluations divided into phase of construction
- Code requirements divided by tiers - (1, 2, 3) based on energy impact
- Values and comments captured, including generic information (building type, use, size, etc.)

---

### Residential Data Collection Checklist

**2009 International Energy Conservation Code**

**Date:**

**Name of Evaluator(s):**

**Building Name & Address:**

**Conditioned Floor Area:** __________ ft²

**Building Contact Name:**

**Phone:**

**Email:**

**Compliance Approach:**

- Prescriptive (402.1.2 or 402.1.3)
- UA Trade-Off (402.1.4)
- Building Performance (405)

**State:**

**Jurisdiction:**

**Building Type:**

- Single Family
- Modular
- Townhouse
- Multi-family
- Apartment
- Condominium

**Project Type:**

- New Construction
- Addition to existing building
- Existing building renovation

<table>
<thead>
<tr>
<th>Item Number</th>
<th>Compliance Plan Review</th>
<th>Code Value</th>
<th>Verified Value</th>
<th>Complies</th>
<th>Comments/Notes/Findings</th>
</tr>
</thead>
<tbody>
<tr>
<td>PR1 [103.2]⁴</td>
<td>Construction drawings and documentation available. Documentation includes deficiencies and code compliance.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PR2 [403.6]²</td>
<td>HVAC loads calculations: Heating system size(s): Cooling system size(s):</td>
<td>kBtu: _____</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Additional Comments:**

---

*Note: The checklist and item numbers are placeholders and should be replaced with specific codes and values relevant to the building being evaluated.*
MAGIC NUMBER: Generating a Sample

http://www.energycodes.gov/resource-center
Sample Size / Distribution

- 44 new residential dwellings
- 44 new commercial buildings
- 44 existing residential renovations
- 44 existing commercial renovations
- Distributed throughout state based on population (one Climate Zone)
- Distributed over a representative sample: different building sizes and uses
Thank you for your time!

QUESTIONS??

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