Residential Energy Codes - What’s Coming Down The Line?

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Home Energy Service, Inc.
Presentation Outline
Part 1 – Residential Energy Code Changes
Part 2 – Performance Testing
Part 3 – The Rating Process

2018 Montana State Building Codes Education Conference
The Energy Code Train Departed the Station in 1993 with the first Model Energy Code.

Energy Codes make buildings more comfortable and cost-effective to operate, assuring energy, comfort, and economic benefits.
✓ International Building Code
✓ International Mechanical Code
✓ International Fuel Gas Code
✓ International Property Maintenance Code
✓ International Fire Code
✓ International Zoning Code
✓ International Plumbing Code
✓ International Existing Building Code
✓ International Private Sewage Disposal Code
✓ International Performance Code
✓ International Residential Code
✓ International Energy Conservation Code
✓ International Wildlife-Urban Interface Code
Why do energy codes change?

1. Increase Stringency
2. Decrease Stringency
3. Clarify Language to Improve Compliance
4. To Irritate Construction Industry
Relationship Between IRC and IECC

- IECC adopted by Montana
- IECC addresses only energy
- IECC addresses both residential and commercial buildings

- IRC addresses all topics (*structural, etc.*)
- IRC addresses subset of residential (detached one- and two-family dwellings and townhouses 3 stories or fewer)
- IRC Chapter 11, the energy chapter is not adopted by Montana
Construction Documents (R103.2)

1. Insulation Materials & R-values
2. Fenestration U-Factors
3. Area Weighted U-Factor Calculations
4. Mechanical Systems Design Criteria
5. Mech/DHW Types, Sizes, Efficiencies
6. Equipment Systems and Controls
7. Duct Sealing, Duct & Pipe Insulation
8. Air Sealing Details
Required Inspections (R104)

Footing and Foundation

- Footing and Foundation
- R-value
- Location
- Thickness
- Depth of Burial
- Protection
Required Inspections (R104)

Framing and Rough-in
- Before interior finish
- R-values (Location and Installation)
- Fenestration U-factor
- Air leakage controls
Required Inspections (R104) NEW

**Plumbing Rough-in**

- Types of Insulation
- R-values & Protection
- Required Control
Required Inspections (R104) **NEW**

**Mechanical Rough-in**
- HVAC Equipment Type & Size
- Required Controls
- System Insulation & R-value
- System Air Leakage Control
- Programmable Thermostats
- Dampers
- Whole house ventilation
- Minimum Fan Efficiency
Required Inspections (R104)

Final Inspection (Verification)

- Required Building Systems
- Equipment & Controls (Proper Operation)
- Number of High-Efficacy Lamps & Fixtures
Required Inspections (R104.4)

Approved Inspection Agencies

Code official authorized to accept reports of approved third-party inspection agencies.
Material(s) assembled and joined together to provide a barrier to air leakage through *and into* the building envelope. An air barrier may be a single material or a combination of materials.
Conditioned Space

- Enclosed within Building Thermal Envelope
- Directly or Indirectly Heated or Cooled
- Indirectly Heated or Cooled Spaces Where They
  - Communicate through Openings with Conditioned Spaces
  - Separated by Uninsulated walls, Floors, or Ceilings
  - Contain Uninsulated Ducts, Piping, or Other Sources of Heating or Cooling
Continuous Insulation

- Continuous Across All Structural Members
- Without Thermal Bridges Other Than Fasteners and Service Openings
- May Be Installed on Interior or Exterior
- May Be Integral to Building Envelope
What’s a Thermal Bridge?
Thermal Bridge
Definitions (R202) NEW

Insulated Siding

- Type of Continuous Insulation
- Manufacturer Installed Insulation
- Integral with Cladding Product
- Minimum R-4
Residential Building

- Detached one and two family dwellings
- Multiple single family dwellings and townhouses
- Group R-2, R-3, R-4 <= 3 stories in height
Does Residential or Commercial Apply?

<table>
<thead>
<tr>
<th>Apartments</th>
<th>In this 3-story mixed occupancy building would the commercial or residential sections apply to each floor?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Apartments</td>
<td></td>
</tr>
<tr>
<td>Office/Retail</td>
<td></td>
</tr>
</tbody>
</table>
Does Residential or Commercial Apply?

<table>
<thead>
<tr>
<th>Condominiums</th>
<th>In this 4-story mixed occupancy building, would the commercial or residential sections apply to each floor?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Condominiums</td>
<td></td>
</tr>
<tr>
<td>Condominiums</td>
<td></td>
</tr>
<tr>
<td>Condominiums</td>
<td></td>
</tr>
<tr>
<td>Office/Retail</td>
<td></td>
</tr>
</tbody>
</table>
IECC Climate Zones (R301.1)
## Prescriptive R-Value Table R401.1.1

<table>
<thead>
<tr>
<th>IECC</th>
<th>Fenestration U-Factor</th>
<th>Skylight U-Factor</th>
<th>Ceiling U-factor</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>Crawl Space Wall R-Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>2009</td>
<td>0.33 [0.33]</td>
<td>0.60</td>
<td>49</td>
<td>20 or 13+5 [21 or 13+5]</td>
<td>15/19</td>
<td>30</td>
<td>15/19</td>
<td>10, 4'</td>
<td>10/13 [10/19]</td>
</tr>
<tr>
<td>2012</td>
<td>0.32</td>
<td>0.6</td>
<td>49</td>
<td>20+5 or 13+10 [21 or 13+5]</td>
<td>15/20</td>
<td>30</td>
<td>15/19</td>
<td>10, 4'</td>
<td>15/19</td>
</tr>
<tr>
<td>2015</td>
<td>0.32</td>
<td>0.60</td>
<td>49</td>
<td>20+5 or 13+10</td>
<td>15/20</td>
<td>30</td>
<td>15/19</td>
<td>10, 4'</td>
<td>15/19</td>
</tr>
<tr>
<td>2018</td>
<td>0.30</td>
<td>0.6</td>
<td>49</td>
<td>20+5 or 13+10</td>
<td>15/20</td>
<td>30</td>
<td>15/19</td>
<td>10, 4'</td>
<td>15/19</td>
</tr>
</tbody>
</table>

**REVISED Past MT Amendment**
Window U-Factor (R402.3.2)

Lower means less heat loss.

Source: www.nfrc.org
The air has water in it. Who would have guessed?
Window Condensation
Is it Magic?
Source: Lawrence Berkeley National Laboratory
Drying Potential - Cold Climate

Exterior
Cooler
Lower Humidity

Semi-Permeable

Primary Drying to the Exterior

Interior
Warmer
Higher Humidity

Vapor Retarder Layer Semi-Impermeable

Secondary Drying to the Interior
Effective R-Value of Wall Types
Based on % Framing and Insulation Grade

Annual Consumption MMBtu/Yr

- 2x6, 24", R21+5 (15%)
- 2x6, 16", R21+5 (23%)
- 2x4, 24", R13+10 (15%)
- 2x4, 16", R13+10 (23%)
- 2x6, 24", R21 (15%)
- 2x6, 16", R21 (23%)
Exterior Sheathing Temperature – No Insulation

Inside
70°F
45°F Dew Point

Outside
30°F
55°F Sheathing Surface Temperature
Exterior Sheathing Temperature – **With Insulation**

**Inside**
- 70°F
- 45°F Dew Point

**Outside**
- 30°F

34°F Sheathing Surface Temperature
For **Diffusion:**
Vapor Retarder

For **Air Transport:**
Air Barrier
Vapor Diffusion vs. Air Transport

Source: USDOE Building Technologies Program, Whole-House Energy Savings in Cold and Very Cold Climates
Nominal:       R19                       R19 + R5                  R19 + R10 
Effective:     R14.4                       R-19.4                      R-23.8
Code Change Question

Require continuous wall insulation?
Walls with Partial Structural Sheathing (R402.2.7)

If structural sheathing covers ≤40% of gross wall area........ The continuous insulation R-value may be reduced enough to result in a consistent total sheathing thickness (but not more than R-3) on areas of walls covered by structural sheathing.
Mass Wall Provisions (R402.2.5)

- **Above-ground Walls**
  - Concrete Block
  - Insulated Concrete Form (ICF)
  - Masonry Cavity
  - Brick (not brick veneer)
  - Compressed Earth Block
  - Solid Timber or Solid Logs
  - Rammed Earth
  - Adobe

- **Capacity ≥ 6 Btu/ft\(^2\)**
Mass Walls

R-15 If More Than Half of Insulation on the Exterior

R-20 More Than Half of Insulation on the Interior

R402.2.5
ICC 400 Log Home Standard (R402.1)

NEW

2018 IECC Deems ICC 400 Requirements for *Thermal Envelope* equal to the IECC*

* - All other IECC provisions apply.
ICC 400 Log Home Standard (R402.1)

ICC 400 Includes:

- Log Grading
- Moisture Content
- Structural Design
- Settling Allowances
- Fire Resistance
- Thermal Performance - 3 Compliance Methods
  - Prescribed
  - Test Method
  - Calculation Method
# ICC 400 Log Home Standard (R402.1) NEW

## Thermal Envelope Prescribed Method (305.1.1.2)

Insulation and Fenestration Requirements by Component Table 305.3.1.2

<table>
<thead>
<tr>
<th>Log Wall W&lt;sub&gt;L&lt;/sub&gt;</th>
<th>Fenestration U-Factor</th>
<th>Skylight U-Factor</th>
<th>Ceiling U-factor</th>
<th>Wood Frame Wall R-Value</th>
<th>Floor R-Value</th>
<th>Basement/Crawl Wall R-Value</th>
<th>Slab R-Value &amp; Depth</th>
<th>Heated Slab R-Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>5” if SG ≤ 0.50</td>
<td>0.33</td>
<td>0.60</td>
<td>49</td>
<td>20 or 13+5</td>
<td>30</td>
<td>15/19</td>
<td>15, 4’</td>
<td>15</td>
</tr>
<tr>
<td>7” if SG &gt; 0.50</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Ponderosa Pine SL=0.4
Western Larch SL=0.52
Lodgepole Pine SL=0.41
Building Envelope Air Tightness
The same testing and air tightness requirements apply to log walls as for any other method of construction.

Vapor Retarder Exception
As noted in Exception 3 of IRC Section R702.7
Not required in “construction where moisture or its freezing will not damage the materials.”
There is no cavity to protect in a log wall.......
The 2018 IECC refers to the IRC vapor retarder provisions which require that walls comply with IRC R702.7.

**Class I or II vapor retarder at warm side of wall required.**
Exception: Basement Walls and any portion of below grade walls.

Class III is allowed for:
- Vented cladding
- Continuous Insulation
  - R-7.5 for 2x4 wall
  - R11.25 for 2x6 wall
## Vapor Retarders

<table>
<thead>
<tr>
<th>Class</th>
<th>Definition</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>0.1 perm or less</td>
<td>Sheet polyethylene, sheet metal, non-perforated aluminum foil</td>
</tr>
<tr>
<td>II</td>
<td>Greater than 0.1 perm to less than 1.0 perm</td>
<td>Kraft-faced fiberglass batts or low-perm paint</td>
</tr>
<tr>
<td>III</td>
<td>Greater than 1.0 perm to less than 10 perm</td>
<td>Latex or enamel paint</td>
</tr>
</tbody>
</table>

**Impermeable** (vapor barrier)

**Semi-impermeable**

**Semi-permeable**

---

Source: USDOE Building Technologies Program, *Whole-House Energy Savings in Cold and Very Cold Climates*
Vapor Retarder and Air Barrier Code Summary

Continuous Air Barrier in Building Envelope

Class I or II Vapor Retarder – Above Grade Walls
Ceilings Without Attic Spaces (R402.2.2)

Where not enough room in joist space to achieve prescribed R-value:

IECC
R-30 is allowed for up to 500 Ft2 for 20% of ceiling area, whichever is less.

Montana Amendment
R-30 is allowed for up to 250 Ft2 for 10% of ceiling area, whichever is less.
Unvented Attics & Cathedral Ceilings

Unvented Attic (IRC R806.5.5.1)
Air Impermeable Insulation Only

1. Air Impermeable Insulation in Direct Contact with Sheathing

2. Air Impermeable Insulation must be Class II Vapor Retarder or Have a Class III Vapor Retarder on the Underside.

3. Class I Vapor Retarder Not Allowed
Unvented Enclosed Rafter Assembly
(R806.5.5.1)
Air Impermeable Insulation Only

1. Air Impermeable Insulation in Direct Contact with Sheathing

2. Air Impermeable Insulation must be Class II Vapor Retarder or Have a Class III Vapor Retarder on the Underside. Class I Vapor Retarder Not Allowed
Unvented Attics & Cathedral Ceilings

Unvented Attic (IRC R806.5.5.2)
Air Impermeable Only

1. Rigid Board Insulation Above Sheathing \( \geq R-25 \)

2. Air Permeable Insulation in Direct Contact with Sheathing \( \geq R-24 \)

3. Class I Vapor Retarder Not Allowed
Unvented Attics & Cathedral Ceilings

Unvented Attic (IRC R806.5.5.3)
Air-Impermeable and
Air-Permeable Insulation

1. Air-Impermeable Insulation in Direct Contact with Sheathing Min. R-25
2. Air-Permeable Insulation in Direct Contact with Air-Impermeable Insulation
3. Class I Vapor Retarder Not Allowed
Vertical Access Hatches (R402.2.4)


Allows vertical doors that provide access from conditioned to unconditioned spaces to meet the fenestration requirements.
Air Leakage (Mandatory; R402.4)
Thermal envelope must comply with both:

**Testing** (402.4.1.2)

Air Barrier and Insulation Installation (Table R402.4.1)

“Where required by the code official, testing shall be conducted by an approved third party.”

Past MT Amendment
<table>
<thead>
<tr>
<th>Component</th>
<th>Air Barrier Criteria</th>
<th>Insulation Installation Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>General requirements</td>
<td>A continuous air barrier shall be installed in the building envelope. The exterior thermal envelope contains a continuous air barrier. Breaks or joints in the air barrier shall be sealed.</td>
<td>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>
<td>The insulation in any dropped ceiling/soffit shall be aligned with the air barrier.</td>
</tr>
<tr>
<td>Walls</td>
<td>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.</td>
<td>Cavities within corners and headers of frame walls shall be insulated by completely filling the cavity with a material having a thermal resistance of R-3 per inch minimum. Exterior thermal envelope insulation for framed walls shall be installed in substantial contact and continuous alignment with the air barrier.</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>
<td></td>
</tr>
</tbody>
</table>

*(partial table)*
# Building Envelope Air Tightness (R402.4.1.2)

<table>
<thead>
<tr>
<th>Year</th>
<th>IECC</th>
<th>Montana</th>
</tr>
</thead>
<tbody>
<tr>
<td>2009</td>
<td>7 ACH50</td>
<td>4 ACH50</td>
</tr>
<tr>
<td>2012</td>
<td>3 ACH50</td>
<td>4 ACH50</td>
</tr>
<tr>
<td>2015</td>
<td>3 ACH50</td>
<td>??</td>
</tr>
<tr>
<td>2018</td>
<td>3 ACH50</td>
<td>??</td>
</tr>
</tbody>
</table>

Past MT Amendment
Building Tightness Testing (Blower Door)

Air In = Air Out

\[ (-) \leq 4 \text{ ACH50} \]
City of Missoula Building Tightness Testing

Missoula Single Family Homes ACH50 2015-2017

Average 2.70 ACH50
City of Missoula Building Tightness Testing

Missoula Multifamily Units ACH50 2015-2017

Average 3.16 ACH50
City of Missoula Building Tightness Testing

Missoula All Units ACH50 2015-2018

Average 2.88 ACH50
Code Change Question

What building enclosure tightness limit (ACH50)?
Envelope Air Leakage Testing (402.4.1.2)

2012 IECC
Bare bones procedure.

2015 IECC
Required either ASTM E 779 or ASTM E 1827.

2018 IECC – Added RESNET/ICC 380-2016 Standard to acceptable procedures.
Combustion Closets (R402.4.4)

Open combustion fuel burning appliances and combustion air opening shall:

Be located outside the building thermal envelope; OR

Enclosed in a room isolated from inside the thermal envelope

- Sealed and insulated per Table R402.1.2
- Door gasketed and sealed
- Any ducts or water lines insulated per R403
- Combustion air duct insulated to ≥ R-8 where it passes through conditioned space
Exceptions:

- Direct vent appliances with both intake and exhaust pipes installed continuous to outside

- Fireplaces and stoves complying with R402.4.2 and Section R1006-IRC
Code Change Question

Require combustion appliance closets?
# Duct Insulation

## Duct Insulation (R403.3.1) NEW

<table>
<thead>
<tr>
<th>Location</th>
<th>≥3-inch</th>
<th>&lt;3 inch</th>
</tr>
</thead>
<tbody>
<tr>
<td>Conditioned Space</td>
<td>NA</td>
<td>NA</td>
</tr>
<tr>
<td>Vented Attic</td>
<td>R-8</td>
<td>R-6</td>
</tr>
<tr>
<td>Vented Crawlspace</td>
<td>R-6</td>
<td>R-4.2</td>
</tr>
<tr>
<td>Conditioned Crawlspace</td>
<td>NA</td>
<td>NA</td>
</tr>
<tr>
<td>Conditioned Basement</td>
<td>NA</td>
<td>NA</td>
</tr>
<tr>
<td>Unconditioned Basement</td>
<td>R-6</td>
<td>R-4.2</td>
</tr>
<tr>
<td>Exterior Walls</td>
<td>R-6</td>
<td>R-4.2</td>
</tr>
</tbody>
</table>
Ducts Buried Within Ceiling Insulation (R403.3.3)

- Supply and Return Duct Insulation R-8 or R-4.2
- Ceiling Insulation Around Ducts R-19 Minimum
Ducts Located in Conditioned Space (R403.3.7)

1. Completely within continuous air barrier; or
2. Buried per R403.3.6 and air handler located in conditioned space; and maximum leakage rate is less than or equal to 1.5 cfm/100 ft² by either:
   a. Rough-in Total Leakage Test
   b. Post-construction Leakage to Outside Test

Important only for ERI.
Total Duct Leakage Test

Source: NCAT
Duct Leakage to the Outside

Supply and Return Registers Must be Sealed

Source: NCAT
Duct Tightness Testing (R403.3.3) Per IECC

**Postconstruction Test**
Total Leakage Test
\( \leq 4 \text{ cfm/100 SF (at 25 PA)} \)

**Rough-in Test**
Total Leakage Test
With Air Handler Installed \( \leq 4 \text{ cfm/100 SF (at 25 PA)} \)
Without Air Handler Installed \( \leq 3 \text{ cfm/100 SF (at 25 PA)} \)

*Testing not required if ducts and air handler entirely within building thermal envelope.*
Duct Tightness Testing (R403.3.3) Amended

Postconstruction Test
Total Leakage or Leakage to the Outside <= 4 cfm/100 SF (at 25 PA)

Rough-in Test
Total Leakage Test <= 4 cfm/100 SF (at 25 PA)

Past MT Amendment

Testing not required if ducts and air handler entirely within building thermal envelope.
Code Change Question

Allow Leakage to the Outside Test?
Duct Tightness Testing (R403.3.3)

Duct Tightness Testing Report
A written report of results of test signed by the party conducting test must be provided to code official.

HRV & ERV Ducts Exception
Testing not required for ducts serving ERVs and HRVs.
Building Cavities for Returns (403.3.5)

- 2012 through 2018 IECC prohibits using cavities as supply or return ducts.
- Montana amended 2012 IECC to allow cavities for returns.

Past MT Amendment
“Build it tight and ventilate it right”
Mechanical Ventilation Types

- Exhaust Only Mechanical Ventilation
- Supply Only Mechanical Ventilation
  Not recommended for the Montana climate.
- Balanced Mechanical Ventilation without Heat Recovery
- Balanced Mechanical Ventilation with Heat Recovery
Ventilation System Types

Stand alone

Integrated (with central air)
Integrated Balanced Exhaust without Heat Recovery

Balanced ventilation system with fresh air intake integrated with air handler and exhaust fan(s).
Heat Recovery Ventilator (HRV)

Stale air to outside
Fresh air to your home

Fresh air from outside
Stale air from your home

Recovery core where the warm inside air transfers its heat and moisture to the cold incoming fresh air

Air filters
Exhaust from H/AC Return and Distribution of Fresh Air through H/AC System

Source: Aldes
Clarifying Language…but no major changes.

1. Exhaust air must be to outside and not through another dwelling.
2. Does not prohibit ductless range hoods (but ductless range hoods do not count as ventilation).
3. Dwelling unit exhaust equipment labeled as providing minimum airflow per ANSI/AMCA 210 or AMSI/ASHRAE 51.
Minimum ventilation values table not changed but formula added:

\[ \text{CFM} = (0.01 \times \text{total house Ft}^2) + [7.5 \times (\text{number of bedrooms} + 1)] \]
# Mechanical Ventilation (IRC M1505)

<table>
<thead>
<tr>
<th>DWELLING UNIT FLOOR AREA (square feet)</th>
<th>0-1</th>
<th>2-3</th>
<th>4-5</th>
<th>6-7</th>
<th>&gt; 7</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 1,500</td>
<td>30</td>
<td>45</td>
<td>60</td>
<td>75</td>
<td>90</td>
</tr>
<tr>
<td>1,501 - 3,000</td>
<td>45</td>
<td>60</td>
<td>75</td>
<td>90</td>
<td>105</td>
</tr>
<tr>
<td>3,001 - 4,500</td>
<td>60</td>
<td>75</td>
<td>90</td>
<td>105</td>
<td>120</td>
</tr>
<tr>
<td>4,501 - 6,000</td>
<td>75</td>
<td>90</td>
<td>105</td>
<td>120</td>
<td>135</td>
</tr>
<tr>
<td>6,001 - 7,500</td>
<td>90</td>
<td>105</td>
<td>120</td>
<td>135</td>
<td>150</td>
</tr>
<tr>
<td>&gt; 7,500</td>
<td>105</td>
<td>120</td>
<td>135</td>
<td>150</td>
<td>165</td>
</tr>
</tbody>
</table>

Note: Manual override required.
### Mechanical Ventilation (IRC M1505)

<table>
<thead>
<tr>
<th>DWELLING UNIT FLOOR AREA (square feet)</th>
<th>NUMBER OF BEDROOMS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0-1</td>
</tr>
<tr>
<td>&lt; 1,500</td>
<td>30</td>
</tr>
<tr>
<td>1,501 - 3,000</td>
<td>45</td>
</tr>
<tr>
<td>3,001 - 4,500</td>
<td>60</td>
</tr>
</tbody>
</table>

**Airflow in CFM**

- For a dwelling unit floor area of 1,501 - 3,000 square feet, the airflow rate requirement for 2-3 bedrooms is 60 CFM.
**TABLE M1507.3.3(2)**

Intermittent Whole-House Mechanical Ventilation Rate Factors

<table>
<thead>
<tr>
<th>Run-Time Percent in Each 4-Hour Segment</th>
<th>25%</th>
<th>33%</th>
<th>50%</th>
<th>66%</th>
<th>75%</th>
<th>100%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Factor</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1.5</td>
<td>1.3</td>
<td>1.0</td>
</tr>
</tbody>
</table>

**Exhaust Ventilation**

- Central exhaust fan
- Exhaust air outlet
- Air flow
- Air infiltration
- Positive pressure
- Negative pressure

**Balanced Ventilation**

- Room air exhaust ducts
- Exhaust fan
- Supply fan
- Air flow
- Air infiltration
- Positive pressure
- Negative pressure
## Local Exhaust Ventilation (if installed)

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 50 cfm intermittent or 20 cfm continuous</td>
</tr>
</tbody>
</table>
Whole House Ventilation Example

3BR, 2000 SF House = 60 CFM

60 CFM Continuous Exhaust Fan

100 CFM Manual Exhaust Fan
Whole House Ventilation Example

4BR, 3600 SF House = 90 CFM
**Mechanical Ventilation Fan Efficacy (R403.6.1)**

Whole-house mechanical ventilation system fans to meet efficacy in Table R403.6.1

**Exception** When fans are integral to tested and listed HVAC equipment, powered by electronically commutated motor

<table>
<thead>
<tr>
<th>Fan Location</th>
<th>Air Flow Minimum (CFM)</th>
<th>Minimum Efficacy (cfm/watt)</th>
<th>Air Flow Rate Maximum (CFM)</th>
</tr>
</thead>
<tbody>
<tr>
<td>HRV or ERV</td>
<td>Any</td>
<td>1.2</td>
<td>Any</td>
</tr>
<tr>
<td>Range Hoods</td>
<td>Any</td>
<td>2.8</td>
<td>Any</td>
</tr>
<tr>
<td>In-Line Fan</td>
<td>Any</td>
<td>2.8</td>
<td>Any</td>
</tr>
<tr>
<td>Bathroom, Utility Room</td>
<td>10</td>
<td>1.4</td>
<td>&lt; 90</td>
</tr>
<tr>
<td>Bathroom, Utility Room</td>
<td>90.0</td>
<td>2.8</td>
<td>Any</td>
</tr>
</tbody>
</table>

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

### NEW
Systems Serving Multiple Dwelling Units (R403.8)

Systems serving multiple dwelling units shall comply with Sections C403 and C404 in lieu of Section R403.
High Efficacy Lighting (R404.1) NEW

90%

High Efficacy Lamps
High Efficacy Lighting (R404.1)
Energy Rating Index (R406) NEW

Prescriptive

Prescriptive

Simulated Performance

Energy Rating Index

R-Value (No Tradeoffs)

U-Factor (component tradeoffs)

Total UA (tradeoffs between components)

Simulated Performance Approach R405

ERI Compliance Alternative R406
It’s official:
ANSI/RESNET Standard 301-2014

HERS® Index

Zero Energy Home
Reference Home
Existing Homes

Less Energy

More Energy

©2013 RESNET

2012 IECC
2009 IECC
2006 IECC
Energy Rating Index (ERI) (R406)

About 1/3 of All Homes are Rated

1,942,252

TOTAL Number of HERS-rated Homes to Date

Number of homes HERS-rated in 2016

206,583
Builders use it ...

CONTINUOUS IMPROVEMENT IN AVERAGE HERS INDEX SCORE

RESNET HOME ENERGY RATINGS INDEX

HIGHER ENERGY COSTS

LOWER ENERGY COSTS

150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0

130 TYPICAL RESALE HOME

100 TYPICAL NEW HOME

65

KB HOME'S ZERHOUS 2.0 HOMES (WHERE AVAILABLE)
States that Allow the ERI Compliance Option in the International Energy Conservation Code® (IECC®)

As of February 2017

[Map showing states in green that allow the ERI Compliance Option in the IECC (Section R 406)]
Energy Rating Index (R406)

Why advocated by major national production builders?

Heating and Cooling System Tradeoffs!
Energy Rating Index (ERI) (R406)

- Minimum Score 2015 IECC is 54.
- Minimum Score 2016 IECC is 61.
- Score of 100 equates to the levels prescribed in the 2006 IECC
- Score of Zero is equivalent to a net-zero-energy home
- Like RESNET’s Home Energy Rating System (HERS) Rating System
- House must also meet the minimum envelope requirements of the 2009 IECC and all of the mandatory code provisions.
Renewables in the ERI Compliance Path

NEW

Renewable Energy May Now Be Included

- Without renewables backstop is 2009 IECC for thermal envelope.
- With renewables backstop is 2015 IECC for thermal envelope.

<table>
<thead>
<tr>
<th>Climate Zone</th>
<th>2018 ERI Score</th>
<th>2015 ERI Scores</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 – 2</td>
<td>57</td>
<td>52</td>
</tr>
<tr>
<td>3</td>
<td>57</td>
<td>51</td>
</tr>
<tr>
<td>4</td>
<td>62</td>
<td>54</td>
</tr>
<tr>
<td>5</td>
<td>61</td>
<td>55</td>
</tr>
<tr>
<td>6</td>
<td>61</td>
<td>54</td>
</tr>
<tr>
<td>7-8</td>
<td>58</td>
<td>53</td>
</tr>
</tbody>
</table>
Energy Rating Index (ERI) (R406)

NEW

ANSI/RESNET/ICC 301-2014
Basis of ERI approach
Energy Rating Index (ERI) (R406)

Completed by an approved third party with documentation, including compliance reports, that must be reviewed by the code official.

It makes sense that ERI Raters become ICC certified as Residential Energy Inspectors.
REScheck Software

Great for Total UA Tradeoffs but Can’t Do ERI

Download http://www.energycodes.gov/rescheck
Code Change Question

Allow ERI Compliance?
A new chapter has been added to deal specifically with existing buildings.
Existing Building Chapter 5

Alterations
Repairs
Additions
Change of Occupancy

NEW

Unaltered Portions of Building Need Not Comply
Existing Building Chapter 5

Additions

- Addition Complies as Single Building
- Addition & Existing as Single Building
- Addition + Existing Energy Use < Existing

Envelope, HVAC, Hot Water Systems, & Lighting

Must Comply with Chapter 4
- Envelope leakage testing is required.
- When less than 40’ of new duct is added duct testing is not required.
Building Envelope - Must Comply with Chapter 4

Exceptions:

- Storm windows over existing fenestration
- Surface-applied window film installed on existing single pane
- Exposed, existing ceiling, wall or floor cavities if already filled with insulation
- Where existing roof, wall or floor cavity isn’t exposed
- Roof recover
- Roofs without cavity insulation and neither sheathing nor insulation is exposed during the reroofing - Insulate either above or below the sheathing
Existing Building Chapter - Alterations

Must Comply with Chapter 4

- Heating & Cooling Systems
- Service Hot Water Systems
- Lighting
- Change in Space Conditioning

Exceptions:

- When less than 40’ of new duct is added duct testing is not required.
- <50% of luminaries in a space are replaced
Existing Building Chapter - Repairs

Work on nondamaged components necessary for the required repair or damaged components shall be considered part of the repair and are not subject to the alterations requirements.

Considered repairs and not alterations

- Glass-only replacements
- Roof repairs
- Only the bulb and/or ballast within the existing luminaires are replaced if installed interior lighting power does not increase
Solar Ready Provisions

Not Mandatory

- Identify **Solar-Ready Zone** on roof
  (at least 600 Ft², between 110° and 270° of true North)
- No obstructions
- Roof load documentation
- Interconnection pathway
- Reserve electrical service space (in main panel)
- Documentation posted near electric panel
- Exception if shaded >70% of annual daylight hours
I'm not sure

Look for energy code listening sessions coming later this spring...

Let me mullet over
Energy Codes – Recommended Sites

www.energycodes.gov

//deq.mt.gov/Energy/EnergizeMT/energycode
Presentations Online

www.ncat.org
/Energy
/Energy Code Training Presentations