

## **EC81–09/10**

**202 (New), 402.4.1, 402.4.2, 402.4.2.1, 402.4.2.2, 402.4.2.3, Table 402.4.2; IRC R202 (New), N1102.4.1, N1102.4.2, N1102.4.2.1, N1102.4.2.2, N1102.4.2.3, Table N1102.4.2**

**Proponent:** Bill Prindle, ICF International, representing the Energy Efficient Codes Coalition; Jeff Harris, Alliance to Save Energy; Harry Misuriello, American Council for an Energy-Efficient Economy (ACEEE); Garrett Stone, Brickfield, Burchette, Ritts & Stone; Steve Rosenstock, Edison Electric Institute; Brian Dean, ICF International

**THIS IS A 2 PART CODE CHANGE. PART I WILL BE HEARD BY THE IECC COMMITTEE. PART II WILL BE HEARD BY THE IRC BUILDING/ENERGY COMMITTEE. SEE THE TENTATIVE HEARING ORDERS FOR THESE COMMITTEES.**

### **PART I – IECC**

#### **1. Add new definition as follows:**

**SPECIFIC LEAKAGE AREA (SLA).** The air leakage area (L) per conditioned floor area (CFA) of a home (L/CFA), where leakage area (L) is defined in accordance with Section 5.1 of ASHRAE 119 and where L and CFA are in the same units.

#### **2. Revise as follows:**

**402.4.1 Building thermal envelope.** The *building thermal envelope* shall comply with Section 402.4.2 and be durably sealed to limit infiltration. The sealing methods between dissimilar materials shall allow for differential expansion and contraction. The following shall be caulked, gasketed, weatherstripped or otherwise sealed with an air barrier material, suitable film or solid material:

1. All joints, seams and penetrations.
2. Site-built windows, doors and skylights.
3. Openings between window and door assemblies and their respective jambs and framing.
4. Utility penetrations.
5. Dropped ceilings or chases adjacent to the thermal envelope.

6. Knee walls.
7. Walls and ceilings separating a garage from conditioned spaces.
8. Behind tubs and showers on exterior walls.
9. Common walls between dwelling units.
10. Attic access openings.
11. Rim joist junction.
12. Other sources of infiltration.

**402.4.2 Air sealing and insulation.** The components of the building thermal envelope as listed in Table 402.4.2 shall be installed in accordance with the manufacturer's instructions and the criteria listed in Table 402.4.2, as applicable to the method of construction. Building envelope air tightness and insulation installation shall be demonstrated to comply with one of the following options given requirements established by Section 402.4.2.1 or and 402.4.2.2:

**402.4.2.1 Performance testing requirement option.** The building shall meet the air leakage standard set forth below as demonstrated by an air leakage test conducted as specified below:

1. Building envelope tightness and insulation installation shall be considered acceptable when tested by a party approved by the code official. Where required by the code official, the approved party shall be independent from both the builder and any other entity responsible for installing the insulation and air barrier and otherwise sealing the building. A written report specifying the results of the test and attesting to the accuracy of the results shall be signed by the party conducting the testing and provided to the builder and code official.
2. The building shall be required to have an air leakage is less than 0.00030 specific leakage area (SLA) seven air changes per hour (ACH) when tested with a blower door at a pressure of 33.5 psf (50 Pa). Testing shall occur any time after rough in and after (i) installation of all penetrations of the building envelope, including penetrations for utilities, plumbing, electrical, ventilation, and combustion appliances, and (ii) completion of sealing of the building thermal envelope as required in section 402.4.1.
3. During testing:
  1. Exterior windows and doors, fireplace and stove doors shall be closed, but not sealed beyond the weather-stripping, caulking and other intended permanent air infiltration control measures;
  2. Dampers shall be closed, but not sealed, including exhaust, intake, makeup air, backdraft, fireplace and flue dampers beyond intended permanent air infiltration control measures;
  3. Interior doors connecting conditioned spaces shall be open, doors connecting to unconditioned spaces closed but not sealed;
  4. Exterior openings for continuous ventilation systems and heat recovery ventilators shall be closed and sealed;
  5. Heating and cooling system(s) shall be turned off;
  6. HVAC ducts systems shall not be sealed; and
  7. Supply and return registers shall be fully open at the time of the test not be sealed.

**Exception:** Multi-family residential buildings, with more than four dwelling units per building, may be individually exempted from the testing requirement only when meeting all of the following requirements:

1. The exemption is approved by the code official after inspection of the sealing of thermal envelope in accordance with Section 402.4.1 and Table 402.4.2;
2. At least 15 percent of the units are tested to have an air leakage less than 0.00036 specific leakage area (SLA) when tested with a blower door at a pressure of 33.5 psf (50 Pa), with the units to be tested specified by the code official; and
3. The tests demonstrate compliance for such units.

When any tested dwelling unit subject to this exception fails to meet the maximum air leakage requirement stated in Section 402.4.2.1, then the builder must resolve any leakage problems so that such unit passes the test and then must continue to test each additional dwelling unit in such building until a minimum of three consecutive dwelling units pass the test before the builder can return to testing as specified in subpart (ii) of this Exception.

**402.4.2.2 Visual insulation inspection option (Mandatory).** Building envelope tightness and insulation installation shall be considered acceptable when the items listed in Table 402.4.2, applicable to the method of construction, are field verified to meet the Insulation Installation Criteria in Table 402.4.2. Where required by the code official, an approved party independent from the builder and the installer of the insulation, shall inspect the air barrier and insulation; in such case, a written inspection report, including a checklist demonstrating compliance shall be provided to the code official and builder before interior finish materials are applied.

3. Add new text as follows:

**402.4.2.3 Visual air barrier inspection.** For any building or dwelling unit not required to be tested under section 402.4.2.1, building envelope tightness shall be field verified to meet the Air Barrier Criteria in Table 402.4.2. Where required by the *code official*, an *approved* party independent from the builder and the installer of any air barrier materials, shall inspect the air barrier; in such case, a written inspection report, including a checklist demonstrating compliance shall be provided to the *code official* and builder before interior finish materials are applied. In cases where the building or dwelling unit satisfies the testing requirement of section 402.4.2.1, the *code official* may also require field verification to show that the building meets the Air Barrier Criteria if deemed necessary.

4. Delete Table 402.4.2 and substitute as follows:

**TABLE 402.4.2  
AIR-BARRIER AND INSULATION INSPECTION COMPONENT CRITERIA**

**TABLE 402.4.2  
VISUAL AIR BARRIER AND INSULATION INSPECTION**

<u>COMPONENT</u>	<u>INSULATION INSTALLATION CRITERIA</u>	<u>AIR BARRIER CRITERIA</u>
<u>General Requirements</u>	<u>Exterior thermal envelope insulation for framed walls is installed in substantial contact and continuous alignment with building envelope air barrier.</u>	<u>A continuous air barrier is installed in the thermal envelope.</u> <u>Breaks or joints in the air barrier are sealed.</u> <u>Air permeable insulation is not used as a sealing material.</u>
<u>Ceiling / attic</u>	<u>In any dropped ceiling/soffit, the insulation is substantially aligned with the air barrier.</u>	<u>Air barrier in any dropped ceiling / soffit is substantially aligned with insulation and any gaps are sealed.</u> <u>Attic access, knee wall door or drop down stair to unconditioned attic is sealed.</u>
<u>Walls</u>	<u>All corners and headers are insulated. Insulation is in substantial contact and continuous alignment with air barrier.</u>	<u>Junction of foundation and sill plate is sealed.</u> <u>Junction of exterior wall and top plate is sealed.</u> <u>Junction of the exterior wall and floor sheathing is sealed.</u> <u>Knee wall is sealed.</u>
<u>Fenestration</u>		<u>Space between fenestration jambs and framing is sealed.</u>
<u>Rim joists</u>	<u>Rim joists are insulated.</u>	<u>Air barrier is installed at the rim joist.</u>
<u>Floors (including above garage and cantilevered floors)</u>	<u>Insulation is installed to maintain permanent contact with underside of subfloor decking.</u>	<u>Air barrier is installed at any exposed edge of insulation.</u>
<u>Crawl space walls</u>	<u>Insulation is permanently attached to walls.</u>	<u>Exposed earth in unvented crawlspaces is covered with Class I vapor retarder with overlapping joints taped.</u>
<u>Shafts, penetrations</u>		<u>Duct shafts, utility penetrations, knee walls, and flue shafts opening to exterior or unconditioned space are sealed.</u>
<u>Narrow cavities</u>	<u>Batts in narrow cavities are cut to fit; narrow cavities are filled by sprayed/blown insulation.</u>	
<u>Garage separation</u>		<u>Air sealing is provided between the garage and conditioned spaces.</u>

<b>COMPONENT</b>	<b>INSULATION INSTALLATION CRITERIA</b>	<b>AIR BARRIER CRITERIA</b>
<u>Recessed lighting</u>		<u>Recessed light fixtures installed in the building thermal envelope are airtight, IC rated, and sealed to drywall.</u>
<u>Plumbing and Wiring</u>	<u>Insulation is placed between the exterior of the wall assembly and pipes. Batt insulation is cut and fitted around wiring and plumbing, or sprayed/blown insulation extends between piping and wiring and to the exterior of the wall assembly.</u>	<u>All plumbing and wiring penetrations shall be sealed to the air barrier.</u>
<u>Shower / tub on exterior wall</u>	<u>Exterior walls adjacent to showers and tubs have insulation filling any gaps or voids between tub or shower walls and unconditioned space.</u>	<u>Exterior walls adjacent to showers and tubs have an air barrier separating the exterior wall from the shower and tubs.</u>
<u>Electrical / phone box on exterior walls</u>	<u>Insulation completely fills voids between the box and exterior sheathing.</u>	<u>Air barrier extends behind boxes or air sealed type boxes are installed.</u>
<u>Common wall</u>		<u>Air barrier is installed in common wall between dwelling units.</u>
<u>HVAC register boots</u>		<u>HVAC register boots that penetrate building envelope are sealed to subfloor or drywall.</u>
<u>Fireplace</u>		<u>Air barrier is installed on fireplace walls. Fireplace shall have gasketed doors.</u>

## PART II – IRC BUILDING/ENERGY

### 1. Add new definition as follows:

**SPECIFIC LEAKAGE AREA (SLA).** The air leakage area (L) per conditioned floor area (CFA) of a home (L/CFA), where leakage area (L) is defined in accordance with Section 5.1 of ASHRAE 119 and where L and CFA are in the same units.

### 2. Revise as follows:

**N1102.4.1 Building thermal envelope.** The *building thermal envelope* shall comply with Section N1102.4.2 and be durably sealed to limit infiltration. The sealing methods between dissimilar materials shall allow for differential expansion and contraction. The following shall be caulked, gasketed, weatherstripped or otherwise sealed with an air barrier material, suitable film or solid material.

1. All joints, seams and penetrations.
2. Site-built windows, doors and skylights.
3. Openings between window and door assemblies and their respective jambs and framing.
4. Utility penetrations.
5. Dropped ceilings or chases adjacent to the thermal envelope.
6. Knee walls.
7. Walls and ceilings separating a garage from conditioned spaces.
8. Behind tubs and showers on exterior walls.
9. Common walls between dwelling units.
10. Attic access openings.
11. Rim joist junction.
12. Other sources of infiltration.

**N1102.4.2 Air sealing and insulation.** The components of the *building thermal envelope* as listed in Table N1102.4.2 shall be installed in accordance with the manufacturer's instructions and the criteria listed in Table N1102.4.2, as applicable to the method of construction. Building envelope air tightness and insulation installation shall be demonstrated to comply with ~~one of the following options given~~ requirements established by Section N1102.4.2.1 or and N1102.4.2.2.

**N1102.4.2.1 Performance testing requirement option.** The building shall meet the air leakage standard set forth below as demonstrated by an air leakage test conducted as specified below:

1. Building envelope tightness shall be tested by a party approved by the code official. Where required by the building official, the approved party shall be independent from both the builder and any other entity responsible for installing the insulation and air barrier and otherwise sealing the building. A written report specifying the results of the test and attesting to the accuracy of the results shall be signed by the party conducting the testing and provided to the builder and building official.
2. ~~Fested~~The building shall be required to have an air leakage is less than 0.00030 specific leakage area (SLA)- 7 ACH when tested with a blower door at a pressure of 33.5 psf (50 Pa) pascals (0.007 psi). Testing shall occur any time after rough in and after (i) installation of all penetrations of the building envelope, including penetrations for utilities, plumbing, electrical, ventilation, and combustion appliances, and (ii) completion of sealing of the building thermal envelope as required in section N1102.4.1.
3. During testing:
  1. Exterior windows and doors, fireplace and stove doors shall be closed, but not sealed beyond the weather-stripping, caulking and other intended permanent air infiltration control measures;
  2. Dampers shall be closed, but not sealed, including exhaust, intake, makeup air, backdraft, fireplace and flue dampers beyond intended permanent air infiltration control measures;
  3. Interior doors connecting conditioned spaces shall be open, doors connecting to unconditioned spaces closed but not sealed;
  4. Exterior openings for continuous ventilation systems and heat recovery ventilators shall be closed and sealed;
  5. Heating and cooling system(s) shall be turned off;
  6. ~~HVAC ducts systems shall not be sealed; and~~
  7. ~~Supply and return registers shall be fully open at the time of the test not be sealed.~~

**Exception:** Multi-family residential buildings, with more than four dwelling units per building, may be individually exempted from the testing requirement only when meeting all of the following requirements:

1. The exemption is approved by the building official after inspection of the sealing of thermal envelope in accordance with section N1102.4.1 and Table N1102.4.2;
2. At least 15 percent of the units are tested to have an air leakage less than 0.00036 specific leakage area (SLA) when tested with a blower door at a pressure of 33.5 psf (50 Pa), with the units to be tested specified by the code official; and
3. The tests demonstrate compliance for such units.

When any tested dwelling unit subject to this exception fails to meet the maximum air leakage requirement stated in Section N1102.4.2.1, then the builder must resolve any leakage problems so that such unit passes the test and then must continue to test each additional dwelling unit in such building until a minimum of three consecutive dwelling units pass the test before the builder can return to testing as specified in subpart (ii) of this Exception.

**N1102.4.2.2 Visual insulation inspection option.** The items listed in Table N1102.4.2, applicable to the method of construction, are Building envelope insulation installation shall be field verified to meet the Insulation Installation Criteria in Table N1102.4.2. Where required by the building official, an approved party independent from the builder and the installer of the insulation, shall inspect the air barrier and insulation; in such case, a written inspection report, including a checklist demonstrating compliance shall be provided to the building official and builder before interior finish materials are applied.

**3. Add new text as follows:**

**N1102.4.2.3 Visual air barrier inspection.** For any building or dwelling unit not required to be tested under Section N1102.4.2.1, building envelope tightness shall be field verified to meet the Air Barrier Criteria in Table N1102.4.2. Where required by the building official, an approved party independent from the builder and the installer of any air barrier materials, shall inspect the air barrier; in such case, a written inspection report, including a checklist demonstrating compliance shall be provided to the building official and builder before interior finish materials are applied. In cases where the building or dwelling unit satisfies the testing requirement of Section N1102.4.2.1, the building official may also require field verification to show that the building meets the Air Barrier Criteria if deemed necessary.

4. Delete Table N1102.4.2 and substitute as follows:

**TABLE N1102.4.2  
AIR BARRIER AND INSULATION INSPECTION**

**TABLE N1102.4.2  
VISUAL AIR BARRIER AND INSULATION INSPECTION**

<b>COMPONENT</b>	<b>INSULATION INSTALLATION CRITERIA</b>	<b>AIR BARRIER CRITERIA</b>
<u>General Requirements</u>	<u>Exterior thermal envelope insulation for framed walls shall be installed in substantial contact and continuous alignment with building envelope air barrier.</u>	<u>A continuous air barrier is installed in the thermal envelope.</u> <u>Breaks or joints in the air barrier are sealed.</u> <u>Air permeable insulation is not used as a sealing material.</u>
<u>Ceiling / attic</u>	<u>In any dropped ceiling/soffit, the insulation shall be substantially aligned with the air barrier.</u>	<u>Air barrier in any dropped ceiling / soffit is substantially aligned with insulation and any gaps are sealed.</u> <u>Attic access, knee wall door or drop down stair to unconditioned attic is sealed.</u>
<u>Walls</u>	<u>All corners and headers are insulated.</u> <u>Insulation shall be substantial contact and continuous alignment with air barrier.</u>	<u>Junction of foundation and sill plate is sealed.</u> <u>Junction of exterior wall and top plate is sealed.</u> <u>Junction of the exterior wall and floor sheathing is sealed.</u> <u>Knee wall is sealed.</u>
<u>Fenestration</u>		<u>Space between fenestration jambs and framing is sealed.</u>
<u>Rim joists</u>	<u>Rim joists are insulated.</u>	<u>Air barrier is installed at the rim joist.</u>
<u>Floors (including above garage and cantilevered floors)</u>	<u>Insulation is installed to maintain permanent contact with underside of subfloor decking.</u>	<u>Air barrier is installed at any exposed edge of insulation.</u>
<u>Crawl space walls</u>	<u>Insulation is permanently attached to walls.</u>	<u>Exposed earth in unvented crawlspaces is covered with Class I vapor retarder with overlapping joints taped.</u>
<u>Shafts, penetrations</u>		<u>Duct shafts, utility penetrations, knee walls, and flue shafts opening to exterior or unconditioned space are sealed.</u>
<u>Narrow cavities</u>	<u>Batts in narrow cavities are cut to fit; narrow cavities shall be filled by sprayed/blown insulation.</u>	
<u>Garage separation</u>		<u>Air sealing is provided between the garage and conditioned spaces.</u>
<u>Recessed lighting</u>		<u>Recessed light fixtures installed in the building thermal envelope are airtight, IC rated, and sealed to drywall.</u>
<u>Plumbing and Wiring</u>	<u>Insulation shall be placed between the exterior of the wall assembly and pipes. Batt insulation is cut and fitted around wiring and plumbing, or sprayed/blown insulation extends between piping and wiring and to the exterior of the wall assembly.</u>	<u>All plumbing and wiring penetrations shall be sealed to the air barrier.</u>
<u>Shower / tub on exterior wall</u>	<u>Exterior walls adjacent to showers and tubs have insulation filling any gaps or voids between tub or shower walls and unconditioned space.</u>	<u>Exterior walls adjacent to showers and tubs have an air barrier separating the exterior wall from the shower and tubs.</u>
<u>Electrical / phone box on exterior walls</u>	<u>Insulation completely fills voids between the box and exterior sheathing.</u>	<u>Air barrier extends behind boxes or air sealed type boxes are installed.</u>
<u>Common wall</u>		<u>Air barrier is installed in common wall between dwelling units.</u>
<u>HVAC register boots</u>		<u>HVAC register boots that penetrate building envelope are sealed to subfloor or drywall.</u>
<u>Fireplace</u>		<u>Air barrier is installed on fireplace walls. Fireplace shall have gasketed doors.</u>

**Reason:** Properly controlling air leakage and properly installing insulation are both critical to achieving additional energy savings in homes. In particular, reasonable control of air leakage can have an enormous positive effect on building energy efficiency. Since the builder is already required to properly install insulation and seal the building, the only true incremental cost is the cost of testing and inspection. This cost is fairly small compared to the benefits of proper sealing and insulation installation.

The changes approved in the 2009 *IECC* and *IRC* in this area improved existing code language by setting out clear steps for inspection and offering a testing option for air leakage. We are submitting this proposed modification because we believe that the code language and requirements can be substantially improved. For example, while the testing option as written will address air leakage (if this option is utilized), it does not address proper insulation installation. On the other hand, the inspection option does not guarantee reduced air leakage; the only way to guarantee it is to require testing.

In order to address these important issues, the proposed modification includes the following major improvements:

1. Makes both testing (with a written report) and a more limited visual inspection required;
2. Permits the code official to require independent testing and inspection with written reports;
3. Reduces the burden on code officials by reducing their inspection requirements by eliminating those requirements no longer necessary as a result of the test;
4. Replaces air changes per hour (ACH) with Specific Leakage Area (SLA), a more accurate and consistent measure, as the standard, improves the testing protocol and requires better air leakage performance; and
5. Separates the insulation installation inspection criteria from the air barrier inspection criteria to allow for each to be required or exempted based on the whether testing is conducted.

These changes will make this code change more enforceable and a substantial improvement in energy efficiency over the language in the current code. The following table portrays estimated savings from these measures:

	Climate Zone 1	Climate Zone 2	Climate Zone 3	Climate Zone 4	Climate Zone 4M	Climate Zone 5	Climate Zone 6	Climate Zone 7	Climate Zone 8
Heating, Cooling, Hot Water Purchased Energy Cost Percent Savings	2.1%	3.2%	4.0%	6.3%	6.2%	7.4%	11.7%	9.2%	8.6%
Total Purchased Energy Cost Percent Savings (also including major appliances and lighting)	1.5%	2.3%	2.9%	4.8%	4.8%	5.6%	9.3%	7.0%	6.8%

These energy savings are among the largest of the package of proposals submitted by the EECC. It is thus especially crucial to attaining the overall goal of improving the IECC by 30%.

This proposal also requires multifamily housing in excess of four units to be tested to a testing requirement. However in recognition of the differences in this type of housing, the requirement is 20% less stringent than a single family home to account for leakage to other conditioned space. The multifamily testing exemption also allows for sampling of 15% of the units similar to other sampling procedures by ENERGY STAR and RESNET due to issues related to testing larger multifamily buildings.

**Cost Impact:** The code change proposal will increase the cost of construction.

**PART I – IECC**

Public Hearing: Committee: AS AM D  
 Assembly: ASF AMF DF

**PART II – IRC BUILDING/ENERGY**

Public Hearing: Committee: AS AM D  
 Assembly: ASF AMF DF

ICCFILENAME: PRINDLE-EC-19-202-402.4-R202-N1102.2.4