

EC81-09/10 Part I & Part II

EECC Requested Final Action: Approved as Modified by the Public Comment

EECC Reason Statement:

EC81 should be approved as modified by this public comment.

EC81 as modified will improve both the energy efficiency and the clarity of insulation installation and air barrier requirements in the code, while ensuring that homes meet a reasonable tested air leakage standard. The modification in this public comment adopts the general approach to air leakage inspection and testing in EC13 and EC79, including numbering the sections so that it can work directly with the EC13 and EC79 language. At the same time, this approach is intended to capture the additional improvements included in the version of EC81 as submitted (beyond the energy efficiency of EC13), and to cleanup wording and section numbers as requested in testimony at the Committee Hearings.

EC81 as modified establishes clearer requirements that will achieve higher energy efficiency. This includes:

- (1) tightening tested air leakage requirements for climate zones 1-2 to be consistent with the requirements in the remaining zones;
- (2) requiring testing in all cases except for an appropriate limited exception for multifamily buildings (eliminating the more vague sampling exception and the exception for additions established through EC13 and EC79)
- (3) organizing insulation inspection requirements and air barrier inspection requirements in a compliance-friendly side-by-side table,
- (4) creating greater consistency between the performance and prescriptive paths as to air leakage in the IECC based on the proposed prescriptive path changes (note the proposed modifications to Table 405.5.2(1));
- (5) requiring the insulation inspection in all cases and allowing the code official to avoid an unnecessary visual air barrier inspection when the building meets the air leakage test; and
- (6) removing the unnecessary language from the proposal as submitted that explicitly permitted code officials to require independent parties to do air leakage tests– this language is unnecessary since the test is required to be conducted by an *approved* party (as a result, the code official or jurisdiction can require independence as part of the approval process if desired).

This public comment also picks up various improvements that are in EC13, including using ACH instead of SLA for air leakage testing requirements and removing the redundant requirements in section 402.4.1.

EECC Proposed Modification to Original Proposal:

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 402.4.1.1, 402.4.1.2, 402.4.1.3 and 402.4.1.4 ~~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.~~

402.4.1.1 Installation ~~402.4.2 Air sealing and insulation.~~ The components of the *building thermal envelope* as listed in Table 402.4.1.1 ~~402.4.2~~ shall be installed in accordance with the manufacturer's instructions and the criteria listed in Table 402.4.1.1 ~~402.4.2~~, as applicable to the method of construction. Building envelope air tightness and insulation installation shall be demonstrated to comply with the requirements established by Section 402.4.1.2 ~~402.4.2.1~~ and 402.4.1.3 ~~402.4.2.2~~.

402.4.1.2 ~~402.4.2.1 Performance testing requirement.~~ 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 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 less than ~~0.00030 *specific leakage area (SLA)*~~ five air changes per hour (ACH50) when tested with a blower door at a pressure of ~~33.5 psf~~ 0.2 inches w.g. (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 weatherstripping, 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. Supply and return registers shall be fully open at the time of the test.

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 ~~402.4.1.1~~ ~~402.4.2~~;
2. at least 15% of the units are tested and each tested unit has to have an air leakage less than ~~0.00036 specific leakage area (SLA)~~ seven air changes per hour (ACH50) when tested with a blower door at a pressure of ~~33.5 psf~~ 0.2 inches w.g. (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 this exception ~~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.

402.4.1.3 ~~402.4.2.2~~ Visual insulation inspection (Mandatory). Building envelope insulation installation shall be inspected and field verified to meet the Insulation Installation Criteria in Table ~~402.4.1.1~~ ~~402.4.2~~ before interior finish materials are installed. ~~Where required by~~ The code official, or an approved party independent from the builder and the installer of the insulation, shall inspect the insulation; ~~Where an approved party conducts the inspection, 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:

402.4.1.4 ~~402.4.2.3~~ Visual air barrier inspection. For any building or dwelling unit not required to be tested under section ~~402.4.1.2~~ ~~402.4.2.1~~, building envelope tightness shall be field verified to meet the Air Barrier Criteria in Table ~~402.4.1.1~~ ~~402.4.2~~. Visual air barrier inspection shall be completed prior to the installation of air permeable insulation. ~~Where required by~~ The code official, or an approved party independent from the builder and the installer of any air barrier materials, shall inspect the air barrier; ~~Where an approved party conducts the inspection, 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 ~~402.4.1.2~~ ~~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~~ Revise as follows:

**TABLE ~~402.4.1.1~~ ~~402.4.2~~
VISUAL AIR BARRIER AND INSULATION INSPECTION**

COMPONENT	INSULATION INSTALLATION CRITERIA	AIR BARRIER CRITERIA
General Requirements	Exterior thermal envelope insulation for framed walls is installed in substantial contact and continuous alignment with building envelope air barrier.	A continuous air barrier is installed in the thermal envelope. Breaks or joints in the air barrier are sealed. Air permeable insulation is not used as a sealing material.
Ceiling / attic	In any dropped ceiling/soffit, the insulation is substantially aligned with the air barrier.	Air barrier in any dropped ceiling / soffit is substantially aligned with insulation and any gaps are sealed. Attic access, knee wall door or drop down stair to unconditioned attic is sealed.
Walls	All corners and headers are insulated. Insulation is in substantial contact and continuous alignment with air barrier.	Junction of foundation and sill plate is sealed. Junction of exterior wall and top plate is sealed. Junction of the exterior wall and floor sheathing is sealed. Knee wall is sealed.
Fenestration		Space between fenestration jambs and framing is sealed.
Rim joists	Rim joists are insulated.	Air barrier is installed at the rim joist.

Floors (including above garage and cantilevered floors)	Insulation is installed to maintain permanent contact with underside of subfloor decking.	Air barrier is installed at any exposed edge of insulation.
Crawl space walls	Insulation is permanently attached to walls.	Exposed earth in unvented crawlspaces is covered with Class I vapor retarder with overlapping joints taped.
Shafts, penetrations		Duct shafts, utility penetrations, knee walls, and flue shafts opening to exterior or unconditioned space are sealed.
Narrow cavities	Batts in narrow cavities are cut to fit; narrow cavities are filled by sprayed/blown insulation.	
Garage separation		Air sealing is provided between the garage and conditioned spaces.
Recessed lighting		Recessed light fixtures installed in the building thermal envelope are airtight, IC rated, and sealed to drywall.
Plumbing and Wiring	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.	All plumbing and wiring penetrations shall be sealed to the air barrier.
Shower / tub on exterior wall	Exterior walls adjacent to showers and tubs have insulation filling any gaps or voids between tub or shower walls and unconditioned space.	Exterior walls adjacent to showers and tubs have an air barrier separating the exterior wall from the shower and tubs.
Electrical / phone box on exterior walls	Insulation completely fills voids between the box and exterior sheathing	Air barrier extends behind boxes or air sealed type boxes are installed.
Common wall		Air barrier is installed in common wall between dwelling units.
HVAC register boots		HVAC register boots that penetrate building envelope are sealed to subfloor or drywall.
Fireplace		Air barrier is installed on fireplace walls. Fireplace shall have gasketed doors.

5. Revise as follows:

(Where portions of the tables are not shown, the text is not revised by this code change proposal)

**TABLE 405.5.2(1)
SPECIFICATIONS FOR THE STANDARD REFERENCE AND PROPOSED DESIGNS**

BUILDING COMPONENT	STANDARD REFERENCE DESIGN	PROPOSED DESIGN
Air Exchange Rate	<p><i>Specific leakage area (SLA)⁴ = 0.00036 assuming no energy recovery.</i></p> <p><u>Air leakage rate of 5 air changes per hour in zones 1 through 8 at a pressure of 0.2 inches w.g., (50 Pa).</u></p> <p><u>The mechanical ventilation rate shall be in addition to the air leakage rate and the same as in the proposed design, but no greater than $0.01 \times CFA + 7.5 \times (N_{br} + 1)$ where:</u></p> <p><u>CFA = conditioned floor area</u> <u>N_{br} = number of bedrooms</u></p> <p><u>Energy recovery shall not be assumed for mechanical ventilation.</u></p> <p><u>Exception: For multifamily buildings, the air leakage shall be 7 ACH50 assuming no energy recovery when tested with a blower door at a pressure of 0.2 inches w.g., (50 Pa).</u></p>	<p><u>The measured air exchange rate as determined through testing in accordance with Section 402.4.1.2.</u></p> <p><u>The mechanical ventilation rate shall be in addition to the air leakage rate and shall be as proposed.</u></p> <p>For residences that are not tested, the same as the standard reference design.</p> <p>For residences without mechanical ventilation that are tested in accordance with ASHRAE 119, Section 5.1, the measured air exchange rate^e but not less than 0.35 ACH.</p> <p>For residences with mechanical ventilation that are tested in accordance with ASHRAE 119, Section 5.1, the measured air exchange rate^e combined with the mechanical ventilation rate, f which shall not be less than $0.01 \times CFA + 7.5 \times (N_{br} + 1)$ where:</p>

		CFA = conditioned floor area N_{br} = number of bedrooms
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d. Where leakage area (L) is defined in accordance with Section 5.1 of ASHRAE 119 and where:
 $SLA = L/CFA$
where L and CFA are in the same units.

Part II – IRC

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 Sections N1102.4.1.1, N1102.4.1.2, N1102.4.1.4 and N1102.4.1.4 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.~~

N1102.4.1.1 Installation ~~**N1102.4.2 Air sealing and insulation.**~~ The components of the *building thermal envelope* as listed in Table N1102.4.1.1 ~~N1102.4.2~~ shall be installed in accordance with the manufacturer's instructions and the criteria listed in Table N1102.4.1.1 ~~N1102.4.2~~, as applicable to the method of construction. Building envelope air tightness and insulation installation shall be demonstrated to comply with the requirements established by Section N1102.4.1.2 ~~N1102.4.2.1~~ and N1102.4.1.3 ~~N1102.4.2.2~~.

N1102.4.1.2 ~~**N1102.4.2.1 Performance testing requirement.**~~ 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. The building shall be required to have an air leakage is less than ~~0.00030~~ *specific leakage area (SLA)* ~~five~~ air changes per hour (ACH) when tested with a blower door at a pressure of ~~33.5 psf~~ 0.2 inches w.g. (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 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. Supply and return registers shall be fully open at the time of the test.

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 N1102.4.1.1 ~~N1102.4.2~~;
2. at least 15 percent of the units are tested and each tested unit has to have an air leakage less than ~~0.00036 specific leakage area (SLA)~~ seven air changes per hour (ACH) when tested with a blower door at a pressure of ~~33.5 psf~~ 0.2 inches w.g. (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 this exception ~~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.

N1102.4.1.3 ~~N1102.4.2.2~~ Visual insulation inspection. Building envelope insulation installation shall be inspected and field verified to meet the Insulation Installation Criteria in Table N1102.4.1.1 ~~N1102.4.2~~ before interior finish materials are installed. ~~Where required by~~ The building official, or an approved party independent from the builder and the installer of the insulation, shall inspect the insulation; Where an approved party conducts the inspection, 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:

N1102.4.1.4 ~~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 N1102.4.1.1 ~~N1102.4.2~~. Visual air barrier inspection shall be completed prior to the installation of air permeable insulation. ~~Where required by~~ The building official, or an approved party independent from the builder and the installer of any air barrier materials, shall inspect the air barrier; Where an approved party conducts the inspection, 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 N1102.4.1.2 ~~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~~ Revise as follows:

**TABLE N1102.4.1.12
VISUAL AIR BARRIER AND INSULATION INSPECTION**

COMPONENT	INSULATION INSTALLATION CRITERIA	AIR BARRIER CRITERIA
General Requirements	Exterior thermal envelope insulation for framed walls is installed in substantial contact and continuous	A continuous air barrier is installed in the thermal

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

Proposal History:

Committee Recommended Action on Original Proposal at Public Hearing:

Part I IECC – Disapproved

Part II IRC – Disapproved

Committee Reason(s) for Recommended Action:

Part I IECC – The approach taken and language used in EC13 is preferred. For instance EC13 uses the ACH metric rather than SLA. EC13 takes a different approach for sampling that is preferred. This proposal would allow air permeable insulation outside of the air barrier, which is undesirable.

Part II IRC – The code change proposal regarding sampling would require some discretion on the part of the building official that could lead to accusations of impartial application of the code. Terminology changes (SLA instead of ACH) could cause confusion

Initial Recommendation of EECC: Approve

Initial Proposal for Reference:

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>

COMPONENT	INSULATION INSTALLATION CRITERIA	AIR BARRIER CRITERIA
<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. ~~Tested~~ 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 6. 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**

<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 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>
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<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>
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<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

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