2019 GROUP B PROPOSED CHANGES TO THE I-CODES ALBUQUERQUE COMMITTEE ACTION HEARINGS

April 28 - May 8, 2019
Albuquerque Convention Center, Albuquerque, NM
2019 GROUP B – PROPOSED CHANGES TO THE
INTERNATIONAL ENERGY CONSERVATION CODE

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ENERGY

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icc committee action hearings :::: april, 2019
The following is the tentative order in which the proposed changes to the code will be discussed at the public hearings. Proposed changes which impact the same subject have been grouped to permit consideration in consecutive changes.

Proposed change numbers that are indented are those which are being heard out of numerical order. Indentation does not necessarily indicate that one change is related to another. Proposed changes may be grouped for purposes of discussion at the hearing at the discretion of the chair. Note that some RE code change proposals may not be included on this list, as they are being heard by another committee. Note also that RE1 – RE12 are moved to later in the hearing order to allow grouping consideration of proposed changes to Chapters 1 and 3 near the beginning of the consideration of Chapters 1 and 3 of the IECC-Commercial Provisions.

| RE15-19 | CE42-19 Part II | RE18-19 | CE93-19 Part II |
| RE16-19 | CE51-19 Part II | RE19-19 | RE105-19 |
| RE17-19 | CE54-19 Part II | RE20-19 | RE106-19 |
|        | RE21-19 | RE22-19 | RE8-19 |
|        | RE23-19 | RE24-19 | RE107-19 |
|        | CE62-19 Part II | RE25-19 | CE151-19 Part II |
|        | CE64-19 Part II | RE26-19 | CE115-19 Part II |
|        | RE27-19 | CE78-19 Part II | CE116-19 Part II |
|        | RE28-19 | RE29-19 | RE108-19 |
|        | RE30-19 | RE31-19 | RE109-19 |
|        | RE32-19 | RE33-19 | RE110-19 |
|        | RE34-19 | RE35-19 | RE111-19 |
|        | RE36-19 | RE37-19 | RE112-19 |
|        | RE38-19 | RE39-19 | RE113-19 |
|        | RE40-19 | RE41-19 | RE114-19 |
|        | CE60-19 Part II | RE42-19 | RE115-19 |
|        |        | RE43-19 | RE116-19 |
|        |        | RE44-19 | RE117-19 |
|        |        | RE45-19 | RE118-19 |
|        |        | RE46-19 | RE119-19 |
|        |        | RE47-19 | RE120-19 |
|        |        | RE48-19 | RE121-19 |
|        |        | RE49-19 | RE122-19 |
|        |        | RE50-19 | RE123-19 |
|        |        | RE51-19 | RE124-19 |
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|        |        | RE53-19 | RE126-19 |
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|        |        | RE57-19 | RE130-19 |
|        |        | RE58-19 | RE131-19 |
|        |        | RE59-19 | RE132-19 |
|        |        | RE60-19 | RE133-19 |
|        |        | RE61-19 | RE134-19 |
|        |        | RE62-19 | RE135-19 |
|        |        | RE63-19 | RE136-19 |
|        |        | RE64-19 | RE137-19 |
|        |        | RE65-19 | RE138-19 |
|        |        | RE66-19 | RE139-19 |
|        |        | RE67-19 | RE140-19 |
|        |        | RE68-19 | RE141-19 |
|        |        | RE69-19 | RE142-19 |
|        |        | RE70-19 | RE143-19 |
CE150-19 Part II  RE172-19  RE224-19 Part II
RE124-19 RE173-19  CE1-19 Part I
RE125-19 RE174-19  ADM9-19 Part III
CE159-19 Part II RE175-19  ADM10-19 Part IV
RE126-19 RE176-19  ADM46 Part IV
RE127-19 RE177-19  CE3-19 Part II
RE128-19 RE178-19  CE4-19 Part I
P1-19 RE179-19  CE5-19 Part II
RE129-19 RE180-19  CE6-19 Part II
RE130-19 RE181-19  CE7-19 Part II
RE131-19 RE182-19  CE8-19 Part II
RE132-19 Part I RE183-19  CE9-19 Part II
RE132-19 Part II RE184-19  CE10-19 Part II
RE133-19 RE185-19  RE1-19
RE134-19 RE186-19  CE11-19 Part II
RE135-19 RE187-19  CE12-19 Part II
RE136-19 RE188-19  CE13-19 Part II
RE137-19 RE189-19  CE15-19 Part II
RE138-19 RE190-19  RE2-19
RE139-19 RE191-19  ADM33-19 Part III
RE140-19 RE192-19  RE3-19
RE141-19 RE193-19  CE16-19 Part II
RE142-19 RE194-19  ADM31-19 Part III
RE143-19 RE195-19  CE17-19 Part II
CE160-19 Part II RE196-19  ADM41-19 Part IV
RE144-19 RE197-19  ADM40-19 Part IV
RE145-19 RE198-19  CE18-19 Part II
RE7-19 RE199-19  CE20-19 Part II
RE146-19 RE200-19  CE19-19 Part II
RE147-19 RE201-19  RE4-19
CE217-19 Part II RE202-19  CE23-19 Part II
RE148-19 RE203-19  CE22-19 Part II
RE149-19 RE204-19  RE5-19
RE150-19 RE205-19  CE29-19 Part II
RE151-19 RE206-19  CE30-19 Part II
RE152-19 RE207-19  CE31-19 Part II
RE153-19 RE208-19  CE28-19 Part II
RE154-19 RE209-19  RE9-19 Part I
RE155-19 RE210-19  RE6-19
RE156-19 RE211-19  CE32-19 Part II
RE157-19 RE212-19  ADM5-19 Part III
RE158-19 RE213-19  CE34-19 Part II
RE159-19 RE214-19  CE36-19 Part II
RE160-19 RE215-19  CE37-19 Part II
RE161-19 RE216-19  RE12-19
CE248-19 Part II RE217-19  RE11-19
RE162-19 CE251-19 Part II  CE40-19 Part II
RE163-19 CE253-19 Part II  RE13-19
RE164-19 RE218-19  RE14-19
RE165-19 RE219-19
RE166-19 RE220-19
RE167-19 RE221-19
RE168-19 RE222-19
RE169-19  ADM43-19 Part IV
RE170-19 RE223-19
RE171-19  CE259-19 Part II
2018 International Energy Conservation Code

Revise as follows:

R102.1.1 (IRC N1101.4) Above code programs. The code official or other authority having jurisdiction shall be permitted to deem a national, state or local energy-efficiency program to exceed the energy efficiency required by this code. Buildings approved in writing by such an energy-efficiency program shall be considered to be in compliance with this code. The requirements identified as “mandatory” in Chapter 4 shall be met. Buildings with written documentation of compliance with ICC 700 at the silver level or above shall be deemed to comply with this code.

Add new text as follows:

700-15: National Green Building Standard

Reason: This adds the specific option for ICC’s above code green standard for residences, the National Green Building Standard. ICC 700 has its own “mandatory” items. Citing ICC 700 in code will mean code enforcement will not need to verify that this above code standard meets code.


Cost Impact: The code change proposal will decrease the cost of construction

This is an option and therefore will not affect cost unless it is chosen. For some this may be a less expensive option, especially if they are choosing to be in compliance with ICC 700

Analysis: The referenced standard, ICC 700-2015, is currently referenced in other 2018 I-codes.
Proponent: Robby Schwarz, EnergyLogic, representing EnergyLogic (robby@nrglogic.com)

**2018 International Energy Conservation Code**

**R103.2 (IRC N1101.5) Information on construction documents.** Construction documents shall be drawn to scale on suitable material. Electronic media documents are permitted to be submitted where approved by the code official. Construction documents shall be of sufficient clarity to indicate the location, nature and extent of the work proposed, and show in sufficient detail pertinent data and features of the building, systems and equipment as herein governed. Details shall include the following as applicable:

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

**R103.2.1 (IRC N1101.5.1) Building thermal envelope depiction.** The building thermal envelope shall be represented on the construction documents.

Add new text as follows:

**R103.2.2 (IRC N1101.5.2) Vapor management declaration.** A vapor management strategy shall be documented on the construction documents. The following shall be addressed:

1. Type and class of vapor retarder used throughout the building, or listed per assembly, to manage moisture migration via diffusion as required by Section R402.1.1.
2. Vapor retarder installation scope of work to ensure proper installation.
3. Whole house ventilation strategy to be used in accordance with Section R403.6 and Section M1505.3 of the International Residential Code to ensure background ventilation moisture control.
4. Spot/local exhaust ventilation strategy to be used in accordance with Section M1505.4.4 of the International Residential Code to manage/remove moisture as it is created.
5. Flashing and weather resistant barrier type and installation details.

**Reason:** Currently the IRC allows one of three vapor retarder strategies to be used in a residential dwelling unit all of which require different levels of installation execution and coordination with the rest of the structure and systems that are built and the energy code features that are required by the IECC. In addition, the three strategies only address diffusion which is one of two means of moisture transport that is occurring in a dwelling unit. Moisture moves in a house by diffusion (which the vapor retarder addresses) but also with air. How we expect to control these two moisture transport mechanisms should be made prominent on the plan set to create more efficient and durable structures. This is especially true since more moisture flows into building assemblies through air transport than by the process of diffusion. This code change proposal promotes a subtle shift in our thinking to understand that moisture management is a combination of components and systems working together to protect the building from moisture related failures.

In the prescriptive section R402.1.1 Vapor retarders are required to be installed and the section refers you to the IRC and the IBC. Vapor Retarders discussed in these sections are an important part of gaining control and predictability of the moisture movement within a dwelling unit, but there is a choice that must be made as to which class of retarder will be installed. The installation of class 1 versus class 3 vapor retarder is significantly different and impacts the efficiency and durability of the structure differently.

This declaration will drive moisture management considerations into the design process resulting in assemblies that will be more moisture resistant and more efficient.

The scope of work requirement will better ensure that especially class 1 vapor retarders are installed to limit the ability of air and moisture from bypassing them and being trapped within assemblies. It should also create a better understanding of where a class 1 vapor retarder should or should not be installed in different climate zones. For example, in climate zone 5 along the front range in Colorado we often see unsealed class 1 vapor retarders (6 mil poly) installed behind drywall on exterior walls, but no vapor retarder installed in other parts of the exterior wall assembly such as rim joist or exterior walls in bathrooms. This declaration would elevate the inconsistency of placement of vapor retarders as their installation would be more clearly thought out on the plan set than it has ever been in the past.

Whole house and spot/local ventilation are another important part of the moisture management strategy. From a whole house ventilation perspective, the code gives three choices of strategies that can be used, some of which work better in certain climate zones than others. The vapor
management declaration, would bring the decision on systems that will be installed to the fore font for review by the plans examiner allowing for conversation prior to building the structure.

**Cost Impact:** The code change proposal will increase the cost of construction
There would be a small cost increase associated with this proposal as the proposal merely brings existing requirements together to be reported on the plan set. I estimate that this would require no more than 1 hour of time of the designer or architect. Approximately $100 - $200.

Proposal # 4536

RE2-19
**RE3-19**

IECC: R105.2.5

**Proponent:** Marilyn Williams, representing NEMA (mar_williams@nema.org)

**2018 International Energy Conservation Code**

Revise as follows:

R105.2.5 Final inspection. The building shall have a final inspection and shall not be occupied until approved. The final inspection shall include verification of the installation of all required building systems, equipment and controls and their proper operation and the required number, efficacy of high-efficiency lamps, luminaires and fixtures.

**Reason:**
1. Increase energy efficiency
2. Reduce inconsistency and application confusion in compliance
3. Increase code interpretation and usability
4. Resolve compliance with application, approval, and inspection

Another proposal has been submitted concerning Section R404.1 Lighting equipment (Mandatory)

**Cost Impact:** The code change proposal will not increase or decrease the cost of construction
Today’s cost to use the more efficient LED lamps and luminaires is now equal to or lower than the cost of CFL lamps.
2018 International Energy Conservation Code

SECTION R202 (IRC N1101.6)

GENERAL DEFINITIONS

Add new definition as follows:

CAVITY INSULATION. Insulating material located between framing members.

Reason: The purpose of this proposal is to coordinate with the definition in IECC-C by adding a definition to IECC-R for cavity insulation to complement the existing definition for continuous insulation. Cavity insulation and continuous insulation relate to the location of insulation materials, not specific material types. Adding this definition will help clarify the code in regard to terms used to explain where insulation components are located.

Cost Impact: The code change proposal will not increase or decrease the cost of construction
The proposal only provides a new definition without any material change to the code or costs of compliance. There should be no cost implications.
2018 International Energy Conservation Code

SECTION R202 (IRC N1101.6)
GENERAL DEFINITIONS

Add new definition as follows:

**EMITTANCE.** The ratio of the radiant heat flux emitted by a specimen to that emitted by a blackbody at the same temperature and under the same conditions.

**Reason:** This definition is needed because the term emittance is used in various sections of the code and in the definition for radiant barrier and reflective insulation. It is consistent with the definition found in the 2021 IBC, ASHRAE and ASTM standards. The term emittance is used in numerous sections of this code including for: Building Envelope Requirements, Equipment Buildings, Roof Solar Reflectance and Thermal Emittance, Minimum Roof Reflectance and Emittance Options, Specifications for the Standard Reference and Proposed Designs, Roofs, and for Specifications for the Standard Reference and Proposed Designs, Walls above-grade.

**Cost Impact:** The code change proposal will not increase or decrease the cost of construction. Adding a definition of EMITTANCE will neither increase or decrease construction costs. This is only a definition and is identical to the definition found in the 2021 IBC and existing ASHRAE and ASTM standards.
RE6-19
IECC: R202 (IRC N1101.6)

Proponent: Jennifer Hatfield, representing American Architectural Manufacturers Association (jen@jhatfieldandassociates.com)

2018 International Energy Conservation Code

SECTION R202 (IRC N1101.6)
GENERAL DEFINITIONS

Revise as follows:

FENESTRATION. Products classified as either vertical fenestration or skylights.
   Skylights. Glass or other transparent or translucent glazing material installed at a slope of less than 60 degrees (1.05 rad) from horizontal, including unit skylights, tubular daylighting devices, and glazing materials in solariums, sunrooms, roofs and sloped walls.

   Vertical fenestration. Windows that are fixed or operable, opaque doors, glazed doors, glazed block and combination opaque/glazed doors composed of glass or other transparent or translucent glazing materials and installed at a slope of not less than 60 degrees (1.05 rad) from horizontal.

Reason: This revision clarifies the types of products that are included in the category of "skylights" and brings the IECC Residential definition in alignment with what is in the 2018 IECC Commercial definition for "skylights" along with providing consistency with the second sentence found in the definition of "skylights and sloped glazing" in the IRC and IBC.

The intent of this change, which was accepted into the 2018 IECC Commercial, IBC and IRC definitions, was to clarify what constitutes skylights and sloped glazing, and to specifically clarify that tubular daylighting devices are to be included within that definition. This clarification is important because all fenestration, both vertical and skylights and sloped glazing, are required to be installed in such a manner as to preserve the integrity of the wall or roof.

Approval of this proposal will clarify that tubular daylighting devices are to be installed in such a manner as to preserve the weather resistant barrier of the roof in residential construction and ensure alignment with the other codebook definitions.

Bibliography: 2018 IECC, Section C202, Skylights; 2018 IBC, Section 202, [BS] Skylights and Sloped Glazing; and 2018 IRC, Section R202, [RB] Skylights and Sloped Glazing

Cost Impact: The code change proposal will not increase or decrease the cost of construction
   The proposal will not increase the cost of construction and simply clarifies which products fall under the category of "skylights" and by default, which do not. There will not be an impact to the cost of construction.
2018 International Energy Conservation Code

SECTION R202 (IRC N1101.6)
GENERAL DEFINITIONS

Revise as follows:

HIGH-EFFICACY LAMPS. LIGHT SOURCES. Compact fluorescent lamps, light-emitting diode (LED) lamps, T-8 or smaller diameter linear fluorescent lamps, or other lamps with an efficacy of not less than the following: 65 lumens per watt, or luminaires with an efficacy of not less than 45 lumens per watt.

1. 60 lumens per watt for lamps over 40 watts.
2. 50 lumens per watt for lamps over 15 watts to 40 watts.
3. 40 lumens per watt for lamps 15 watts or less.

R404.1 (IRC N1104.1) Lighting equipment (Mandatory). Not less than 90 percent of the permanently installed lighting fixtures shall contain only high-efficacy lamps.

Reason: The lighting section includes a requirement for a minimum percentage of "high efficiency lamps." However, the definition of "high efficacy lamps" has not been updated to reflect the changes in the market due to increased federal minimums and greater availability/affordability of LED lighting. Because of this, the code is actually becoming less stringent as the baseline for lighting equipment is raised.

The proposal solves this problem by updating the definitions with lighting requirements that reflect what is actually "high-efficacy" in today's market. The proposal also simplifies the definition by reducing the number of wattage categories. The categories in the residential code are an artifact of incandescent and early compact fluorescent lamp wattages. As lamps have gotten more efficient, the higher wattage categories have become less meaningful. As lamps have gotten more efficient, the higher wattage categories have become less meaningful. Even a "100W equivalent" LED lamp and "60W equivalent" CFL lamps generally uses 15W or less, which is the lower category in the existing definition. As a result, the categories have become largely meaningless.

The proposal also accommodates high efficacy luminaires. Many luminaires on the market do not include lamps and include integrated LEDs instead. The way the current code language is written, these efficient lighting products cannot be used to meet the lighting efficiency requirements in the code. The proposal changes the term in the definition to be more inclusive, adds an efficacy requirement for integrated luminaires, and updates the code language to reflect this update.

Cost Impact: The code change proposal will increase the cost of construction. This change could potentially increase the cost of construction because it requires higher efficacy lighting (lamps and/or fixtures), which will likely eliminate some lower-end CFL options and/or push builders to newer LED technologies. However, the cost of LEDs has been steadily declining over the last several years and is expected to continue to decline. Based on an analysis by the U.S. Department of Energy's Building Energy Codes Program conducted during the 2018 IECC Code Development cycle, the estimated and projected prices for LEDs were $4.84 per lamp compared to CFLs at $3.10 per lamp. However, the rapid expansion of the LED lighting market has changed the economics. A spot check of Home Depot in early 2019 showed that a warm white, 60W equivalent A-lamp is as low as $1.24 for both CFL and LED when purchased in packs. And, LEDs are actually cheaper than CFLs at some sources. At 1000bulbs.com, on online retailer, the same lamps are $1.79/bulb for CFL and $0.99 for LED. Therefore, this code change may actually reduce the cost of construction.
2018 International Energy Conservation Code

SECTION R202 (IRC N1101.6)
GENERAL DEFINITIONS

Add new definition as follows:

PROGRAMMABLE COMMUNICATING THERMOSTAT. A whole building or dwelling unit thermostat that can be monitored and controlled remotely.

SECTION R105
INSPECTIONS

Revise as follows:

R105.2.4 Mechanical rough-in inspection. Inspections at mechanical rough-in shall verify compliance as required by the code and approved plans and specifications as to installed HVAC equipment type and size, required controls, system insulation and corresponding R-value, system air leakage control, programmable communicating thermostats, dampers, whole-house ventilation, and minimum fan efficiency.

Exception: Systems serving multiple dwelling units shall be inspected in accordance with Section C105.2.4.

SECTION R403 (IRC N1103)
SYSTEMS

R403.1.1 (IRC N1103.1.1) Programmable communicating thermostat. The thermostat controlling the primary heating or cooling system of the dwelling unit shall be capable of communicating with sources external to the HVAC system and function as a basic thermostat in the absence of communicating with external sources. The thermostat shall be capable of controlling the heating and cooling system on a daily schedule to maintain different temperature set points at different times of the day. The thermostat shall include the capability to set back or temporarily operate the system and provide remote access to maintain zone temperatures of not less than 55°F (13°C) to not greater than 85°F (29°C). The thermostat shall be programmed initially by the manufacturer with a heating temperature setpoint of not greater than 70°F (21°C) and a cooling temperature setpoint of not less than 78°F (26°C).

Exception: Heating and cooling systems with proprietary internal thermostat communication functions.

Reason: This proposal adds a requirement for residential buildings to provide a communicating programmable thermostat. Communicating thermostats have become commonplace and are available from electronic stores to home improvement stores increasing brand awareness and large growth with installations in existing residential buildings. The U.S. EPA Energy Star website lists a large number of connected and smart thermostats and product manufacturers continue to add more devices and improve the depth of price points for these thermostats.

As home automation has increased in homes new products have been released that allow for occupant comfort, ease of use, convenience, security and simplicity in use. Sales of home automation products and services are projected to continue exponential growth. The use of a connected thermostat can provide energy savings for the occupants and support utilities with their demand programs if the occupant chooses to participate.

Many studies have taken place across the U.S. on these newer thermostat devices and energy savings has been seen in the study results. If actual savings are only a fraction of the study savings, the payback period is very short.

This proposal also retains some requirements from the programmable thermostat requirements in the 2018 IECC. The term and definition “programmable communicating thermostat” is taken from ICC700- National Green Building Standard (NGBS).

The exception allows use of non-connected thermostats if heating or cooling system requires a proprietary control or don't support all of the functionality of the heating or cooling system.

This proposal is modeled after Austin, Texas energy code amendment for connected thermostats.

Potential savings opportunities:
The technical energy savings potential of these individual approaches ranges from 0.3 to 1.1 quads, or 1-5% of the total primary energy consumed by U.S. homes in 2015. Put another way, saving one quad per year is equivalent to the energy consumed by about 3 million people, the electricity produced by 250 coal fired power plants or 56 million metric tons (MMT) of CO2 emissions (DOE 2012) - Fraunhofer USA Center for Sustainable Energy Systems

The Florida PDR project showed average cooling energy savings of 9.6% (498 kWh/year), but with a very high degree of variation. Median savings were 6.3% (219 kWh/year). Particularly given the very short Florida winter heating season. Average savings were 9.5% (39kWh/year) although the median was higher, at 18.5% (35 kWh/year). Space heating savings from the Nest ….. average savings were 9.5% (39kWh/year) although the median was higher, at 18.5% (35 kWh/year). – Florida Solar Energy Center

6% heating savings and 14% cooling savings - 2015 AESP Conference

Average annual gas savings per home as high at 6.0% - Energy Trust of Oregon

Bibliography: Bibliography:
3. AESP Conference February 2015 - Cadmus Presentation – C. Aarish – “Wi-Fi Connected Thermostats” show 6% heating savings and 14% cooling savings

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

Cost Impact: A builder entry communicating programmable thermostat can add $50+ over the cost of a typical weekly programmable thermostat. Cost information available at many online retailers comparing weekly programmable thermostats to connected thermostats.

Proposal # 5480
RE9-19 Part I

PART I — IECC: Part I: R202 (IRC N1101.6)
IRC: Part II: R202

PART II — IRC: R202

Proponent: Donald Sivigny, representing State of MN and Association of Minnesota Building Officials (don.sivigny@state.mn.us)

THIS IS A 2 PART CODE CHANGE. PART I WILL BE HEARD BY THE IECC- RESIDENTIAL COMMITTEE. PART II WILL BE HEARD BY THE IRC BUILDING COMMITTEE. SEE THE TENTATIVE HEARING ORDER FOR THESE COMMITTEES.

2018 International Energy Conservation Code

SECTION R202 (IRC N1101.6)
GENERAL DEFINITIONS

Revise as follows:

ROOF RE-COVER, RECOVER. The process of installing an additional roof covering over an existing roof covering without removing the existing roof covering.

Proposal # 5367
2018 International Residential Code

Revise as follows:

[RB] ROOF RECOVER. The process of installing an additional roof covering over a prepared existing roof covering without removing the existing roof covering.

Reason: This simply changing the language in the definition chapter of the IECC-R (and IRC Chapter 11) to be consistent with definition in IECC-C. This is in conjunction with another proposal to change the definition in IRC Chapter 2 in the same manner so that all are uniform for better code compliance and enforcement.

Cost Impact: The code change proposal will not increase or decrease the cost of construction. As this is only aligning a definition across multiple codes, there is no change in technical requirements. Thus, there is no impact to construction costs.
2018 International Energy Conservation Code

SECTION R202 (IRC N1101.6)
GENERAL DEFINITIONS

Add new definition as follows:

**SAMPLING.** A process where fewer than 100 percent of a builder’s dwellings, dwelling units, or sleeping units are randomly inspected and or tested to evaluate compliance with the requirements of this code.

**Reason:** This definition is to clarify that the practice of sampling includes more than just blower door testing. The approved third party would have the opportunity to sample any requirement of the code in a development or building. This is a concept that needs to be made apparent to everyone who uses the code.

**Cost Impact:** The code change proposal will not increase or decrease the cost of construction.

Proposal # 5507
ENCLOSED REFLECTIVE AIR SPACE. An unventilated cavity with a low-emittance surface bounded on all sides by building components.

REFLECTIVE INSULATION. A material installed in an assembly consisting of one or more enclosed reflective air spaces with a surface emittance of 0.1 or less.

Revised as follows:

R303.1.1 (IRC N1101.10.1) Building thermal envelope insulation. An R-value identification mark shall be applied by the manufacturer to each piece of building thermal envelope insulation that is 12 inches (305 mm) or greater in width. Alternatively, the insulation installers shall provide a certification that indicates the type, manufacturer and R-value of insulation installed in each element of the building thermal envelope. For blown-in or sprayed fiberglass and cellulose insulation, the initial installed thickness, settled thickness, settled R-value, installed density, coverage area and number of bags installed shall be indicated on the certification. For sprayed polyurethane foam (SPF) insulation, the installed thickness of the areas covered and the R-value of the installed thickness shall be indicated on the certification. For reflective insulation, the number and thickness of the enclosed reflective air spaces and the R-value for the installed assembly, shall be listed on the certification. For insulated siding, the R-value shall be on a label on the product's package and shall be indicated on the certification. The insulation installer shall sign, date and post the certification in a conspicuous location on the job site.

Exception: For roof insulation installed above the deck, the R-value shall be labeled as required by the material standards specified in Table 1508.2 of the International Building Code or Table R906.2 of the International Residential Code, as applicable.

Reason: The section at present incorporates requirements that are specific to blown or sprayed fiberglass, cellulose insulation and sprayed polyurethane foam insulation together with general requirements for thermal envelope insulation materials. However, the code is silent on reflective insulations.

The proposal adds specific requirements similar to those for the other insulation materials (as well as appropriate definitions) for a type of material, (reflective insulation) that has been in the market place for over 25 years and has had nationwide distribution and installation. These products are well established and have two associated ASTM Standards, ASTM C727, Standard Practice for Installation and Use of Reflective Insulation in Building Constructions, and ASTM C1224, Standard Specification for Reflective Insulation for Building Applications.

The U.S. Department of Energy’s website on weatherizing homes: https://www.energy.gov/energysaver/weatherize/insulation/types-insulation includes the advantages of reflective insulation systems. It states that reflective systems are most effective in preventing downward heat flow but that the effectiveness depends on spacing. This is the critical reason this code change is needed.

Many states and jurisdictional codes already include references on reflective insulation; the list follows:

IBC: 2018 – Section 720, Section 2614

Florida


- R303.1.1 Building thermal envelope insulation
- Table R303.2.1 Insulation Installation Standards
- R303.2.1.2 Substantial Contact

2017 Florida Building Code, Building, 6th Edition

- Section 2614 Reflective Plastic Core Insulation
- Section 720 Thermal and Sound-Insulating Materials
Minnesota

2015 Minnesota Building Code

- Section 720 Thermal and Sound-Insulating Materials
- Section 2613 Reflective Plastic Core Insulation
- Thermal Insulation Standards 2015, Section 7640.0130, Subpart 7

California

Title 24, 2016, Reference Residential Appendices

- RA4.3 Envelope Measures

**Cost Impact:** The code change proposal will not increase or decrease the cost of construction.
This proposal will not increase the cost of construction because only information regarding reflective insulation is being added.

Proposal # 4105

RE11-19
Add new definition as follows:

RADIANT BARRIER. A material having a low emittance surface of 0.1 or less installed in building assemblies.

Add new text as follows:

R303.1.1.2 (IRC N1101.10.1.1.2) Radiant barrier. Where installed, radiant barriers shall comply with the requirements of ASTM C1313/C1313M and shall have an emittance of 0.1 or less.

Add new standard(s) as follows:

ASTM C1313/C1313M-13:

Standard Specification for Sheet Radiant Barriers for Building Construction Applications

Reason: This proposal DOES NOT require the use of radiant barriers. But rather requires that WHEN radiant barriers are used, they comply with the appropriate ASTM standard. Furthermore this proposal provides important information to the code user and code enforcement community regarding radiant barriers.

Radiant barriers are typically installed in attics to reduce summer heat gains through the roof. According to the DOE's website: https://www.energy.gov/energysaver/weatherize/insulation/radiant-barriers, Radiant barriers help to reduce cooling costs by reducing radiant heat gain. To be effective, radiant barriers are very dependent of their installation because their reflective surface must face an air space.


The proposed language is being included in this section specifically because the American Society for Testing and Materials (ASTM) classifies radiant barriers as thermal insulation. The ASTM committee C16 on Thermal Insulation includes published standards for this product. Subcommittee C16.21 deals specifically with reflective products, which include reflective insulation, radiant barrier and interior radiation control coatings. C16.21 develops standards and practices for these reflective building material thermal insulating products.

The Federal Trade Commission includes radiant barrier products in “CFR Part 460 Labeling and Advertising of Home Insulation: Trade Regulation Rule”.

Radiant barrier products include a surface with an emittance of 0.1 or less that is installed in roof assemblies or attics with the low-emittance surface facing an open or ventilated air space. The low emittance material can be bonded to plastic film, woven fabric, reinforced paper, OSB or plywood. The thermal performance of radiant barriers depends on emittance and location in the attic, wall or roof assembly. Radiant barriers are predominantly installed in attic spaces below the roof deck. The low-emittance surface of radiant barrier products dramatically reduces the heat gain by radiation into the structure and attic HVAC ducts. For this reason, radiant barriers are especially effective in warm sunny climates where they provide reduced use of air conditioning. Radiant barrier products that are available include single-sheet material, multi-layer assemblies and wood sheathing with attached aluminum film or foil. The single sheet material is installed in roof assemblies by attaching directly to the roof deck, in between the rafters or trusses or to the underside of the rafters or trusses. The foil-faced sheathing is installed with the low-emittance side of the sheathing or panel facing toward the attic space to create a radiant barrier. Attic radiant barriers are in extensive use. These products have been on the market for several decades and are used by 87 of the top 100 US Builders. They have an established history and have been accepted into several regional code requirements. Over one billion square feet of the product is being installed annually.

Many state and jurisdictional codes already include references on radiant barriers. These are the state and city codes that include radiant barrier:

IBC: 2018 Section 1509 Radiant Barriers Installed Above Deck
Hawaii - Chapter 181 of Title 3, 2015, Section 407.2, Table 407.1

Texas

- The Code of the City of Austin, Texas, Supplement 1342018, Chapter 25-12, Article 12, Section R402.6

Florida


- Section 405.7.1 Installation Criteria for homes claiming the radiant barrier option
- Figure R405.7.1 Acceptable attic radiant barrier configurations
- Table R303.2.1 Insulation Installation Standards

California

- Title 24, 2016, Part 6, Subchapter 1, Definition Radiant Barrier

Cost Impact: The code change proposal will not increase or decrease the cost of construction
This proposal will not increase the cost of construction because it only adds informational language regarding radiant barriers.

Analysis: A review of the standard proposed for inclusion in the code, ASTM C1313/C1313M-2013, with regard to the ICC criteria for referenced standards (Section 3.6 of CP#28) will be posted on the ICC website on or before April 2, 2019.
2018 International Energy Conservation Code

Revise as follows:

R303.1.3 (IRC N1101.10.3) Fenestration product rating. U-factors of fenestration products such as windows, doors and skylights shall be determined in accordance with NFRC 100.

Exception: Where required, garage door U-factors shall be determined in accordance with either NFRC 100 or ANSI/DASMA 105. U-factors shall be determined by an accredited, independent laboratory, and labeled and certified by the manufacturer.

Products lacking such a labeled U-factor shall be assigned the maximum U factor from Section R402.5. Opaque doors lacking a default U-factor from Table R303.1.3(1) or label shall be assigned a default U-factor from Table R303.1.3 (2). The solar heat gain coefficient (SHGC) and visible transmittance (VT) of glazed fenestration products such as windows, glazed doors and skylights shall be determined in accordance with NFRC 200 by an accredited, independent laboratory, and labeled and certified by the manufacturer. Products lacking such a labeled SHGC shall be assigned the maximum SHGC from Section R402.5.

Exception: For existing buildings complying with Chapter 5, products lacking a labeled U-factor, SHGC or VT shall be assigned a default U-factor, SHGC or VT from Table R303.1.3 (1) through (3).

<table>
<thead>
<tr>
<th>TABLE R303.1.3(1) [IRC N1101.10.3(1)]</th>
<th>DEFAULT GLAZED WINDOW, GLASS DOOR AND SKYLIGHT U-FACTORS</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>FRAME TYPE</strong></td>
<td><strong>WINDOW AND GLASS DOOR</strong></td>
</tr>
<tr>
<td></td>
<td><strong>SINGLEpane</strong></td>
</tr>
<tr>
<td>Metal</td>
<td>1.20</td>
</tr>
<tr>
<td>Metal with Thermal Break</td>
<td>1.10</td>
</tr>
<tr>
<td>Nonmetal or Metal Clad</td>
<td>0.95</td>
</tr>
<tr>
<td>Glazed Block</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>TABLE R303.1.3(2) [IRC N1101.10.3(2)]</th>
<th>DEFAULT OPAQUE DOOR U-FACTORS</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>DOOR TYPE</strong></td>
<td><strong>OPAQUE U-FACTOR</strong></td>
</tr>
<tr>
<td>Uninsulated Metal</td>
<td>1.20</td>
</tr>
<tr>
<td>Insulated Metal</td>
<td>0.60</td>
</tr>
<tr>
<td>Wood</td>
<td>0.50</td>
</tr>
<tr>
<td>Insulated, nonmetal edge, not exceeding 45% glazing, any glazing double pane</td>
<td>0.35</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>TABLE R303.1.3(3) [IRC N1101.10.3(3)]</th>
<th>DEFAULT GLAZED FENESTRATION SHGC AND VT</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>SINGLE GLAZED</strong></td>
<td><strong>DOUBLE GLAZED</strong></td>
</tr>
<tr>
<td>Clear</td>
<td>Tinted</td>
</tr>
<tr>
<td>0.8</td>
<td>0.7</td>
</tr>
</tbody>
</table>

Reason: Because of the mandatory wording of Section R402.5, you could never use the values that are in the residential default tables for new construction. This proposal makes the defaults for unlabeled fenestration that of the maximum mandatory requirements. However, in existing buildings there are times when you will not be able to determine existing U factors or SHGC and the newer mandatory requirements of the new R402.5 are unrealistic, therefore the tables have been saved for those existing buildings. Opaque doors have been left with the default tables and VT was struck from the maximum requirements for new construction because A) that section doesn't cover VT and B) VT is not a residential...
requirement anyway.
The proposal changes the references to the tables, however the tables remain the same.

Cost Impact: The code change proposal will not increase or decrease the cost of construction
Because of the mandatory maximums set in R402.5 you could never use these default tables for new construction.

Staff Analysis: TABLE R303.1.3(1) [IRC N1101.10.3(1)] through R303.1.3(3) [IRC N1101.10.3(3)] remain unchanged.

Proposal # 5321

RE13-19
RE14-19
R303.2 (IRC N1101.11)

Proponent: Eric Makela, New Buildings Institute, representing Northwest Energy Codes Group (ericM@newbuildings.org)

2018 International Energy Conservation Code
Revise as follows:

R303.2 (IRC N1101.11) Installation. Materials, systems and equipment shall be installed in accordance with the manufacturer’s instructions. Grade I insulation installation requirements in RESNET/ICC 301 and the International Building Code or the International Residential Code, as applicable.

Reason: The quality of insulation installation has a significant impact on the performance of the building envelope. When insulation is not properly installed, the code does not achieve the energy savings intended by its insulation requirements. Poorly installed insulation can compromise home performance, resulting in higher energy bills for the builder’s customers and increased customer call backs due to comfort issues. Based on a report by Energy Star Certified Homes, Version 3 (Rev. 08) there is a 5% savings for heating and cooling system consumption on properly installed insulation (Grade I) vs Grade II insulation that includes more gaps, voids and compressions.

The current IECC language requires that insulation be installed to manufacturer’s instructions. This provision is difficult to enforce because installation instructions will vary based on manufacturer and type of installation (e.g. fiberglass batts versus blown fiber glass versus cellulose). Field inspectors normally don’t have ready access to manufacturer’s installation instructors when conducting an insulation inspection. Manufacturers require that their product be installed with minimal gaps, voids and compression which relates to Grade I Insulation installation but based on the U.S. DOE field study conducted in several states, less than 50% of the homes had insulation installed to Grade I insulation quality.

To address this issue, RESNET has created a new insulation installation standard that includes requirements for Grade I insulation installation for different types of insulation (e.g. fiberglass batts, blown fiber glass and cellulose). The standards language is included in latest version of RESNET/ICC Standard 301. The Grade I installation requirement will help standardize how insulation should be installed and can be used as a reference by both the insulation contractor and the building department reducing potential issues in the field over how products should be installed. This can also be used by the builder focused on quality assurance as they will know how the insulation product is require to be installed.

Grade I insulation allows very small gaps in the insulation. Voids are not allowed to extend from the interior to the exterior (i.e. the full width of a wall cavity). The product is required to be installed according to manufacturer’s specification and cut to fit around electrical junction boxes and is split around wires and pipes. Compression or incomplete fill can amount to 2% or less, if the empty spaces are less than 30% of the intended fill thickness.

Cost Impact: The code change proposal will not increase or decrease the cost of construction

There is no cost increase in this code change as the code currently requires insulation to be installed to manufacturer’s installation instruction which is consistent with Grade I insulation installation requirements.
IECC: R401.2 (IRC N1101.13), R401.2.1 (IRC N1101.13.1), R401.2.1 (IRC N1101.13.1) (New), R401.2.2 (IRC N1101.13.2) (New), R401.2.3 (IRC N1101.13.3) (New), R401.2.4 (IRC N1101.13.4) (New), R407 (IRC N1107) (New), R407.1 (IRC N1107.1) (New)

Proponent: David Collins, SEHPCAC, representing SEHPCAC (SEHPCAC@icc safe.org); David Collins, representing The American Institute of Architects (dcollins@preview-group.com)

2018 International Energy Conservation Code

Revise as follows:

R401.2 (IRC N1101.13) Compliance Application. Projects Residential buildings shall comply with Section R401.2.1, R401.2.2, R401.2.3, or R401.2.4, one of the following:

1. Sections R401 through R404.
2. Section R405 and the provisions of Sections R401 through R404 indicated as “Mandatory.”
3. The energy rating index (ERI) approach in Section R406.

Exception: Additions, alterations, repairs and changes of occupancy to existing buildings complying with Chapter 5.

Add new text as follows:

R401.2.1 (IRC N1101.13.1) Prescriptive Compliance. The Prescriptive Compliance Option requires compliance with Sections R401 through R404.

R401.2.2 (IRC N1101.13.2) Total Building Performance. The Total Building Performance Option requires compliance with Section R405, and the provisions of Sections R401 through R404 indicated as “Mandatory.”

R401.2.3 (IRC N1101.13.3) Energy Rating Index. The Energy Rating Index (ERI) Option requires compliance with Section R406.

R401.2.4 (IRC N1101.13.4) Tropical zones. The Tropical Climate Zone alternative requires compliance with Section 407.

SECTION R407 (IRC N1107)
TROPICAL CLIMATE ZONE

R407.1 (IRC N1107.1) Scope. This section establishes alternative criteria for residential buildings in the tropical zone at elevations less than 2,400 feet (731.5 m) above sea level.

Revise as follows:

R407.2 (IRC N1107.2) Tropical zone. Residential buildings in the tropical zone at elevations less than 2,400 feet (731.5 m) above sea level shall be deemed to be in compliance with this chapter provided that the following conditions are met:

1. Not more than one-half of the occupied space is air conditioned.
2. The occupied space is not heated.
3. Solar, wind or other renewable energy source supplies not less than 80 percent of the energy for service water heating.
4. Glazing in conditioned spaces has a solar heat gain coefficient of less than or equal to 0.40, or has an overhang with a projection factor equal to or greater than 0.30.
5. Permanently installed lighting is in accordance with Section R404.
6. The exterior roof surface complies with one of the options in Table C402.3 or the roof or ceiling has insulation with an R-value of R-15 or greater. Where attics are present, attics above the insulation are vented and attics below the insulation are unvent ed.
7. Roof surfaces have a slope of not less than onefourth unit vertical in 12 units horizontal (21-percent slope). The finished roof does not have water accumulation areas.
8. Operable fenestration provides a ventilation area of not less than 14 percent of the floor area in each room. Alternatively, equivalent ventilation is provided by a ventilation fan.
9. Bedrooms with exterior walls facing two different directions have operable fenestration on exterior walls facing two directions.
10. Interior doors to bedrooms are capable of being secured in the open position.
11. A ceiling fan or ceiling fan rough-in is provided for bedrooms and the largest space that is not used as a bedroom.

Reason:
This proposal intends no technical changes. It will make the code clearer and easier to use, particularly if companion proposals to identify ‘mandatory’ provisions in tabular formats are approved.
This proposal reorganizes the general requirements of Chapter 4 of the IECC-R to:

- Retitle R401.2 as “Application” to be consistent with the title of the parallel section in the IECC-C;
- More clearly identify the optional compliance paths available to the designer by providing titles;
- Retitle the R405 “Simulated Performance Alternative” performance option as “Total Building Performance” to be consistent with the title of the parallel section in the IECC-C;
- Relocate the specific technical requirements of the tropical zone alternative from the general section of the code to a standalone section; while providing a reference in the general section to the new tropical zone section;
- Provide a needed reference to the requirements for existing buildings in Chapter 5.

Consistent nomenclature would support training and education, ease of use and code administration.

A separate proposal has been made to relocate all of the ‘mandatory’ requirements of the performance option currently listed in Sec. R401.2(2) to a new table in Sec. R405. This is consistent with approach currently used in R406.2, (mandatory requirements for the ERI alternative) whereby all mandatory requirements are referenced from the section to which they apply. (Note that another separate proposal would move the ‘mandatory’ sections referenced in R406.2 to a new table within R406 to maintain consistency of approach between R405 and R406).

This proposal is submitted by the ICC Sustainable, Energy and High Performance Code Action Committee (SEHPCAC). The SEHPCAC was established by the ICC Board of Directors to pursue opportunities to improve and enhance International Codes with regard to sustainability, energy and high performance as it relates to the built environment included, but not limited to, how these criteria relate to the International Green Construction Code (IgCC) and the International Energy Conservation Code (IECC). In 2018-2019, the SEHPCAC has held five two- or three-day open meetings and numerous workgroup calls, to discuss and debate proposed changes and public comments. Attendees at the meetings and calls included members of the SEHPCAC as well as any interested parties. Related documentation and reports are posted on the SEHPCAC website at: http://www.iccsafe.org/cs/SEHPCAC/Pages/default.aspx

Cost Impact: The code change proposal will not increase or decrease the cost of construction
This proposal restructures and simplifies existing information and simplicity, it does not create or eliminate requirements.
Proponent: William Fay, Energy-Efficient Codes Coalition, representing Energy-Efficient Codes Coalition (bfay@ase.org); Daniel Bresette, Alliance to Save Energy, representing Alliance to Save Energy (dbresette@ase.org); Harry Misuriello, American Council for an Energy-Efficient Economy, representing American Council for an Energy-Efficient Economy (misuriello@verizon.net); Maureen Guttman, BCAP-IBTS, representing BCAP-IBTS (mguttman@bcapcodes.org)

2018 International Energy Conservation Code

Revise as follows:

R401.2 (IRC N1101.13) Compliance. Projects shall comply with all provisions of Chapter 3 as applicable; the provisions of Chapter 4 labeled "Mandatory;" and one of the following:

1. Sections R401 through R404.
2. Section R405 and the provisions of Sections R401 through R404 indicated as "Mandatory."
3. The energy rating index (ERI) approach in Section R406.

Reason: The purpose of this code change proposal is to simplify and clarify the applicability of the IECC's mandatory provisions across all compliance paths. The proposal will also clarify the applicability of Chapter 3 to all compliance paths, including the Energy Rating Index option of Section R406, something that may not be obvious to a code user who may be more familiar with other rating systems. This code change will not change any requirements of the code, but it will bring essential clarification to the applicability of certain measures to all compliance paths. This will improve compliance and enforcement.

Cost Impact: The code change proposal will not increase or decrease the cost of construction. The proposal does not change any requirements, but merely clarifies the application of the code.
2018 International Energy Conservation Code

Revise as follows:

R401.2 (IRC N1101.13) Compliance. Projects shall comply with one of the following:

1. Sections R401 through R404.
2. Section R405 and the provisions of Sections R401 through R404 indicated as “Mandatory.”
3. The energy rating index (ERI) approach in Section R406.
4. The simplified equivalent compliance alternative approach in Section R407.

Add new text as follows:

R407 (IRC N1107)
SIMPLIFIED EQUIVALENT COMPLIANCE ALTERNATIVE

R407.1 (IRC N1107.1) Scope. This section establishes criteria for compliance using heating and cooling load analysis.

R407.2 (IRC N1107.2) Requirements. Compliance with this section requires that the provisions identified in Sections R102.3, R403.5, R403.8, R403.9, R403.10, R403.11, and R404.1 be met.

R407.3 (IRC N1107.3) Equivalent HVAC building load. The ratio of the space cooling load and space heating load to conditioned floor area shall be less than or equal to the values in Table R407.3.

<table>
<thead>
<tr>
<th>CLIMATE ZONE</th>
<th>COOLING LOAD PER SQUARE FOOT</th>
<th>HEATING LOAD PER SQUARE FOOT</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>10.1 Btuh</td>
<td>3.1 Btuh</td>
</tr>
<tr>
<td>1</td>
<td>8.9 Btuh</td>
<td>4.6 Btuh</td>
</tr>
<tr>
<td>2</td>
<td>11.6 Btuh</td>
<td>7.3 Btuh</td>
</tr>
<tr>
<td>3A and 3B</td>
<td>6.5 Btuh</td>
<td>8.5 Btuh</td>
</tr>
<tr>
<td>4A and 4B</td>
<td>7.6 Btuh</td>
<td>8.8 Btuh</td>
</tr>
<tr>
<td>3C</td>
<td>3.3 Btuh</td>
<td>5.8 Btuh</td>
</tr>
<tr>
<td>4C</td>
<td>6.0 Btuh</td>
<td>7.1 Btuh</td>
</tr>
<tr>
<td>5</td>
<td>7.0 Btuh</td>
<td>11.4 Btuh</td>
</tr>
<tr>
<td>6</td>
<td>5.5 Btuh</td>
<td>11.6 Btuh</td>
</tr>
<tr>
<td>7</td>
<td>4.9 Btuh</td>
<td>13.1 Btuh</td>
</tr>
<tr>
<td>8</td>
<td>4.0 Btuh</td>
<td>18.1 Btuh</td>
</tr>
</tbody>
</table>

R407.4 (IRC N1107.4) TESTING

R407.4.1 (IRC N1107.4.1) Air leakage. The building or dwelling unit shall be tested and verified as having an air leakage rate not exceeding the design infiltration rate in the load calculations. Testing shall be conducted in accordance with RESNET/ICC 380, ASTM E779 or ASTM E1827 and reported at a pressure of 0.2 inch w.g. (50 Pascals). Where required by the code official, testing shall be conducted by an approved third party. A written report of the results of the test shall be signed by the party conducting the test and provided to the code official.

Testing shall be performed at any time after creation of all penetrations of the building thermal envelope.

During testing:

1. Exterior windows and doors, fireplace and stove doors shall be closed, but not sealed, beyond the intended weatherstripping or other
infiltration control measures.

2. Dampers including exhaust, intake, makeup air, backdraft and flue dampers shall be closed, but not sealed beyond intended infiltration control measures.

3. Interior doors, where installed at the time of the test, shall be open.

4. Exterior or interior terminations for continuous ventilation systems shall be sealed.

5. Heating and cooling systems, where installed at the time of the test, shall be turned off.

6. Supply and return registers, where installed at the time of the test, shall be fully open.

**R407.4.1 (IRC N1107.4.1) Duct leakage.** Ducts shall be tested in accordance with R403.3.3 and R403.3.4.

**Reason:** This is a refinement of previous code change proposal RE180-16. The committee recommended disapproval for the following reason: “This is a good concept that would be easy to use but the numbers need some refinement.”

This proposal responds to the committee's comment on RE180-16 by providing specific compliance numbers for each climate zone. Weather data from representative cities of each climate zone as suggested by Pacific Northwest National Laboratory (PNNL) was entered in Wrightsoft Manual J software. Thermal envelope values (insulation, fenestration, air leakage) from the prescriptive 2018 IECC path for each climate zone was entered using the PNNL standard house design. This is consistent with PNNL protocol.

R407.2 includes requirements not addressed by heating and cooling load including service hot water, exterior energy use, and lighting. R102.3 is included to highlight the need for supporting mechanical system design documentation.

R407.4 requires testing to demonstrate the building is built as designed. A blower door test may not exceed the design infiltration rate in the load calculations. Ducts have the same testing requirements as the prescriptive path in R403.3.3 and R403.3.4.

The Simplified Equivalent Compliance Alternative provides the designer, engineer and builder team with another path to comply with climate zone equivalent energy performance targets. The peak heating and cooling loads are already calculated by the design team and drives the HVAC equipment size decision. This option rewards design work value that already exists.

This method is intended as an alternate method for complex residential buildings and HVAC system designs. Energy code compliance documentation at permit application will be greatly reduced as the compliance metric does not require volumes of paperwork.

This compliance path will shorten plan review time and reduce costs in both the public and private sectors.

The targets are fuel neutral.

**Note 1** - the climate zones are based on this table:

**TABLE R301.3(2) INTERNATIONAL CLIMATE ZONE DEFINITIONS**

<table>
<thead>
<tr>
<th>ZONE NUMBER</th>
<th>THERMAL CRITERIA</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>IP Units</td>
</tr>
<tr>
<td>0</td>
<td>10000 &lt; CDD50°F</td>
</tr>
<tr>
<td>1</td>
<td>9000 &lt; CDD50°F</td>
</tr>
<tr>
<td>2</td>
<td>6300 &lt; CDD50°F £ 9000</td>
</tr>
<tr>
<td>3A and 3B</td>
<td>4500 &lt; CDD50°F £ 6300 AND HDD65°F £ 5400</td>
</tr>
<tr>
<td>4A and 4B</td>
<td>CDD50°F £ 4500 AND HDD65°F £ 5400</td>
</tr>
<tr>
<td>3C</td>
<td>HDD65°F £ 3600</td>
</tr>
<tr>
<td>4C</td>
<td>3600 &lt; HDD65°F £ 5400</td>
</tr>
<tr>
<td>5</td>
<td>5400 &lt; HDD65°F £ 7200</td>
</tr>
<tr>
<td>6</td>
<td>7200 &lt; HDD65°F £ 9000</td>
</tr>
<tr>
<td>7</td>
<td>9000 &lt; HDD65°F £ 12600</td>
</tr>
<tr>
<td>8</td>
<td>12600 &lt; HDD65°F</td>
</tr>
</tbody>
</table>

For SI: °C = [(°F) - 32]/1.8.

**Note 2** – We provided numbers for Climate Zone 0 using weather data from a CZ0 city (Dubai) but used thermal envelope R and U values and air leakage for CZ1 under the 2018 IECC.

**WHAT TO LOOK FOR ON THE COMPLIANCE DOCUMENTS:**
Following are example load calculations for climate zone 6 in Helena, MT. The heating load highlighted in the report is 27,725 Btuh; divided by the 2,400sqft conditioned floor area of this house gives a Btuh/sqft of 11.55. This is less than the value in table R407.3 and therefore complies. A similar calculation can be done for the cooling load. This house will need to pass a blower door test of 1080cfm at 50 Pa per the highlighted infiltration value in the report.

Cost Impact: The code change proposal will not increase or decrease the cost of construction. This is an option that gives considerable freedom to the design team. Options and flexibility may lower construction cost.

Proposal # 5533

RE17-19
Proponent: Robby Schwarz, EnergyLogic, representing EnergyLogic (robbys@nrglogic.com)

2018 International Energy Conservation Code

Revise as follows:

R401.3 (IRC N1101.14) Certificate (Mandatory). A permanent certificate shall be completed by the builder or other approved party and posted on a wall in the space where the furnace is located, a utility room or an approved location inside the building. Where located on an electrical panel, the certificate shall not cover or obstruct the visibility of the circuit directory label, service disconnect label or other required labels. The certificate shall indicate the predominant R-values of insulation installed in or on ceilings, roofs, walls, foundation components such as slabs, basement walls, crawl space walls and floors and ducts outside conditioned spaces; U-factors of fenestration and the solar heat gain coefficient (SHGC) of fenestration, and the results from any required duct system and building envelope air leakage testing performed on the building. Where there is more than one value for each component, the certificate shall indicate the value covering the largest area. The certificate shall indicate the types and efficiencies of heating, cooling and service water heating equipment. Where a gas-fired unvented room heater, electric furnace or baseboard electric heater is installed in the residence, the certificate shall indicate “gas-fired unvented room heater,” “electric furnace” or “baseboard electric heater,” as appropriate. An efficiency shall not be indicated for gas-fired unvented room heaters, electric furnaces and electric baseboard heaters. Where onsite renewable systems have been installed, the array capacity kilowatt size, inverter efficacy, panel tilt and orientation shall be noted on the certificate.

Reason: Four reasons why this proposal should be supported:

1. The Code requires that the efficiency rating of every energy-related building component of the home be observable or documented. Insulation R-values, furnace AFUE and water heater EF ratings, Window U-value and SHGC, as well as blower door and duct leakage testing results to name a few. Onsite renewables systems are the one exception which this proposal is striving to address.

2. The homebuyer must have access to knowledge of the energy comments of their home. The label required in Section R401.3 provides it with the notable exception of onsite renewables.

3. Green appraisal addendums and energy efficient mortgages are becoming more common in the market and the ability to easily gather the energy component information from a home is especially needed after the first sale. The certificate is to be a permanent feature of the home to allow the value of the efficiency features of the home to be recognized and assessed as an impact on the cost of ownership.

4. Lastly, third-party Inspection agencies, especially those working within section R405 and R406, need this information in order to develop compliance and marketing documents. The inclusion of onsite renewables on this certificate will change the renewable industry by ensuring that the information is passed on to all owners in a timely manner that does not impact receiving the certificate of occupancy or the closing of the home.

Cost Impact: The code change proposal will not increase or decrease the cost of construction
This proposal would not impact the cost of construction. It does not require the inclusion of onsite renewables only the reporting of it when it is installed.

Proposal # 4901
IECC: R401.3 (IRC N1101.14)

Proponent: donald sivigny, State of MN, representing State of MN and Association of Minnesota Building Officials (don.sivigny@state.mn.us)

2018 International Energy Conservation Code

Revise as follows:

R401.3 (IRC N1101.14) Certificate (Mandatory). A permanent building certificate shall be completed by the builder or other approved party and posted on a wall in the space where the furnace is located, a utility room or an approved location inside the building. Where located on an electrical panel, the certificate shall not cover or obstruct the visibility of the circuit directory label, service disconnect label or other required labels. The certificate shall indicate the predominant R-values:

1. The date the certificate is installed;
2. The dwelling address;
3. Residential contractor name and contractor license number, or homeowner name, if acting as the general contractor;
4. The predominant installed R-values, their location, and type of insulation installed in or on ceilings, roofs, walls, rim/band joist, foundation components such as slabs, basement walls, crawl space walls and floors and,
5. Ducts outside conditioned spaces; U-factors of
6. U-factors for fenestration and the solar heat gain coefficient (SHGC) of fenestration;
7. The results from any required duct system and building envelope air leakage testing done on the building;
8. The types, and efficiencies, input ratings, manufacturers, and model numbers and efficiencies of heating, cooling, and service water heating equipment;
9. The structure’s calculated heat loss, calculated cooling load, and calculated heat gain;
10. The certificate shall list the mechanical ventilation system type, location, and capacity
11. The building’s designated continuous and total ventilation rates.
12. The type, size, and location of any make-up air system installed and Combustion air as required for the building performed on the building. Where there is more than one value for each component, the certificate shall indicate the value covering the largest area.

The certificate shall indicate the types and efficiencies of heating, cooling and service water heating equipment. Where a gas-fired unvented room heater, electric furnace or baseboard electric heater is installed in the residence, the certificate shall indicate “gas-fired unvented room heater,” “electric furnace” or “baseboard electric heater,” as appropriate.

An efficiency shall not be indicated for gas-fired unvented room heaters, electric furnaces and or electric baseboard heaters.

Reason: The language in section R401.3 is revised by replacing the word “permanent” in the first sentence with the word “building.” This change is necessary because the term “permanent certificate” is not used in the industry while the term “building certificate” is, and building certificate is the correct term to be used, in that pertains to the document being referenced in this section. The term “permanent” is an ambiguous term in that one person’s definition of permanent is very different than another person’s definition of permanent. Using the term building certificate will add to consistency of the code because we do define the term “Building” in the code.

Additional required items are added to the IECC list of certificate requirements: the date the certificate is posted so that the building is complete and all the information needed can be added to the certificate; the contractor name and license number or the homeowner name and contact information (if acting as the general contractor);[1]; the insulation product and R-values in the Rim/Band joist area because the Rim/Band joist area is typically insulated with a different system or product that the rest of the home; information on the buildings mechanical ventilation system because this system is an important component of the buildings air quality and durability as required by other provisions of the code; and input rating, model numbers, and equipment efficiencies of all the heating and cooling equipment.

These requirements provide consistency with regard to building certificate requirements and a builder can now use the Certificate as a checklist for information that is required at permit application time. Without this information it is virtually impossible to do a complete and proper plan review and know how the building is being built. (See Example)

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

These items are already being calculated and done as part of the building’s construction. All this change is doing is asking for the information at the time of permit application. It is important to design the building and then build to it instead of building it and then trying to make it work with the design. Providing this information up front assures that the building is designed properly and if the specs it will need to be built and inspected to.

Proposal # 5128
Proponent: Jason Vandever, representing Self (jvandever@eepartnership.org)

2018 International Energy Conservation Code
Revise as follows:

R401.3 (IRC N1101.14) Certificate (Mandatory). A permanent certificate shall be completed by the builder or other approved party and posted on a wall in the space where the furnace is located, a utility room or an approved location inside the building. Where located on an electrical panel, the certificate shall not cover or obstruct the visibility of the circuit directory label, service disconnect label or other required labels. The certificate shall indicate the predominant R-values of insulation installed in or on ceilings, roofs, walls, foundation components such as slabs, basement walls, crawl space walls and floors and ducts outside conditioned spaces; U-factors of fenestration and the solar heat gain coefficient (SHGC) of fenestration, and the results from any required duct system and building envelope air leakage testing performed on the building. Where there is more than one value for each component, the certificate shall indicate the value covering the largest area. The certificate shall indicate the types and efficiencies of heating, cooling and service water heating equipment. Where a gas-fired unvented room heater, electric furnace or baseboard electric heater is installed in the residence, the certificate shall indicate “gas-fired unvented room heater,” “electric furnace” or “baseboard electric heater,” as appropriate. An efficiency shall not be indicated for gas-fired unvented room heaters, electric furnaces and electric baseboard heaters. The certificate shall indicate the name of the builder who applied for the building permit, the code edition under which the structure was permitted and the compliance path used.

Reason: This is potentially valuable information to the homeowner or future contractor working on the home

Bibliography: N/A

Cost Impact: The code change proposal will not increase or decrease the cost of construction
Adding a few items to a certification sheet doesn’t cost anything. It is only documentation.
RE21-19
IECC: R401.3 (IRC N1101.14)

Proponent: William Fay, Energy-Efficient Codes Coalition, representing Energy-Efficient Codes Coalition (bfay@ase.org); Daniel Bresette, Alliance to Save Energy, representing Alliance to Save Energy (dbresette@ase.org); Harry Misuriello, representing American Council for an Energy-Efficient Economy (misuriello@verizon.net); Maureen Guttman, BCAP-IBTS, representing BCAP-IBTS (mguttman@bcapcodes.org)

2018 International Energy Conservation Code
Revise as follows:

R401.3 (IRC N1101.14) Certificate (Mandatory). A permanent certificate shall be completed by the builder or other approved party and posted on a wall in the space where the furnace is located, a utility room or an approved location inside the building. Where located on an electrical panel, the certificate shall not cover or obstruct the visibility of the circuit directory label, service disconnect label or other required labels. The certificate shall indicate the predominant R-values of insulation installed in or on ceilings, roofs, walls, foundation components such as slabs, basement walls, crawl space walls and floors and ducts outside conditioned spaces; U-factors of fenestration and the solar heat gain coefficient (SHGC) of fenestration, and the results from any required duct system and building envelope air leakage testing performed on the building. Where there is more than one value for each component of the building envelope, the certificate shall indicate both the value covering the largest area and the area-weighted average value if available. The certificate shall indicate the types, sizes and efficiencies of heating, cooling and service water heating equipment.

Reason: The purpose of this code change proposal is to make minor but important updates to the certificate that will reflect changes made to the IECC in recent code cycles and include other information that will be beneficial for compliance purposes and for future homeowners. Most importantly, for homes with an Energy Rating Index score, the certificate will be required to provide the actual ERI score achieved with and without on-site generation. This proposal would also require the certificate to provide additional detail on thermal envelope efficiency (where available) and HVAC equipment size. This information should all be readily available at construction, and it will take very little effort to transfer it onto the permanent certificate. However, this information may be difficult or impossible to recreate down the road and will be useful for maintenance and future replacement. These are all reasonable improvements to the certificate that will benefit all future owners of the home.

Cost Impact: The code change proposal will not increase or decrease the cost of construction.

The information required by this proposal will already be available at construction. The only change is to require the information to be recorded on the permanent certificate. Over the useful life of the home, we expect that putting this information in one place could save a homeowner significant money and effort.

Proposal # 3076
**IECC: R402.1 (IRC N1102.1)**

**Proponent:** William Fay, Energy-Efficient Codes Coalition, representing Energy-Efficient Codes Coalition (bfay@ase.org); Daniel Bresette, Alliance to Save Energy, representing Alliance to Save Energy (dbresette@ase.org); Maureen Guttman, BCAP-IBTS, representing BCAP-IBTS (mguttman@bcapcodes.org); Harry Misuriello, American Council for an Energy-Efficient Economy, representing American Council for an Energy-Efficient Economy (misuriello@verizon.net)

## 2018 International Energy Conservation Code

Revise as follows:

**R402.1 (IRC N1102.1) General (Prescriptive).** The *building thermal envelope* shall comply with the requirements of Sections R402.1.1 through R402.1.5.

**Exceptions:**

1. The following low-energy buildings, or portions thereof, separated from the remainder of the building by *building thermal envelope* assemblies complying with this section shall be exempt from the *building thermal envelope* provisions of Section R402.

   1.1. Those with a peak design rate of energy usage less than 3.4 Btu/h · ft² (10.7 W/m²) or 1.0 watt/ft² of floor area for space-conditioning purposes.

   1.2. Those that do not contain conditioned space.

2. Log homes. The prescriptive R-value requirement in Table R402.1.2 shall not apply to the opaque walls of log homes where the walls are constructed from logs at least 7 inches in diameter and the homes are designed in accordance with ICC 400.

**Reason:** The purpose of this code change proposal is to clarify, narrow and place reasonable limits on the log homes exception that was added to the 2018 IECC, which will help improve compliance and enforcement, save energy, and improve comfort. Specifically, the proposal will limit the exception to opaque wall R-values, where there are 7-inch or greater diameter logs, rather than permit an exception to all thermal envelope requirements for any log home.

Prior to the 2018 IECC, log homes were required to comply with the same requirements as all other homes. The current overly broad exception was added in 2018, which reduced the energy efficiency requirements for certain log homes and shifted part of compliance from the IECC to ICC 400.

The exception, as currently contained in Section R402.1, may be seen as somewhat ambiguous as to which components of the log home are exempt from the IECC requirements. A strict reading of the actual language of Section R402.1 (which we believe is the correct reading) would only substitute the prescriptive component R-values and U-factors in ICC-400 for the values contained in Sections R402.1.1 through R402.1.5. The remaining requirements in the IECC – including air leakage testing, duct tightness and testing, equipment sizing, etc. -- would still apply. However, some have suggested that the current code language completely exempts log homes from all IECC thermal envelope requirements in favor of ICC-400 -- a huge expansion of the exception that would permit these homes to waste substantially more energy than a home built to the IECC. Our proposal would resolve this issue.

In addition, although we can appreciate the difficulty of achieving code-compliant prescriptive wall R-values in solid log structures, we believe it is unnecessary to exempt these homes from all thermal envelope or any other efficiency requirements – particularly those unrelated to the log walls. By limiting the exception to the opaque walls, this proposal will retain reasonable IECC efficiency requirements for all other parts of the log home as they existed prior to establishing the exception.

This proposal uses 7-inch diameter logs as the cutoff for the exception to help ensure at least some minimum degree of efficiency in the walls. The R-value for wood ranges between 1.41 per inch for most softwoods and 0.71 for most hardwoods. See https://www.energy.gov/energysaver/types-homes/energy-efficiency-log-homes At a 7-inch diameter, the best possible U-factor for a log wall aligns with an R-13 wall (0.084). Depending on the type of wood, the insulating value of the 7-inch log wall could be much less. While these R-values are equal to or substantially less than even the least stringent wood frame wall R-values for climate zones 1 and 2 (R-13), we recognize that there is some additional benefit from log walls with regard to thermal mass. Only log walls thick enough to maintain a reasonable level of efficiency, however, should qualify for the exemption. We believe that the 7-inch proposed minimum diameter is a reasonable compromise.

It should be kept in mind that for log homes that do not fall within this exception, the IECC offers a range of additional compliance options, including the Total UA, performance path, or ERI option to provide ample trade-off flexibility without sacrificing any energy efficiency.


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

For those log homes that would utilize the exception but may no longer qualify, additional costs may be incurred to bring the home into compliance, although the cost would be no greater than before the exception was established in 2018. However, the proposal will reduce operating costs and improve comfort for actual log homeowners and other occupants who will benefit from lower energy costs over the 70 to 100 year expected useful lifetime of a well-built log home.
RE23-19
IECC: TABLE R402.1.2 (IRC N1102.1.2)

Proponent: Jay Crandell, P.E., ARES Consulting, representing Foam Sheathing Committee of the American Chemistry Council

2018 International Energy Conservation Code
Revise as follows:

<table>
<thead>
<tr>
<th>TABLE R402.1.2 (IRC N1102.1.2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>INSLATION AND FENESTRATION REQUIREMENTS BY COMPONENT</td>
</tr>
<tr>
<td>CLIMATEZONE</td>
</tr>
<tr>
<td>-------------</td>
</tr>
<tr>
<td>1</td>
</tr>
<tr>
<td>2</td>
</tr>
<tr>
<td>3</td>
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<tr>
<td>4 except marine</td>
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<tr>
<td>5 andarine 4</td>
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<tr>
<td>3</td>
</tr>
<tr>
<td>7 and 8</td>
</tr>
</tbody>
</table>

NR = Not Required. For SI: 1 foot = 304.8 mm.

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

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

Exception: In Climate Zones 1 through 3, skylights shall be permitted to be excluded from glazed fenestration SHGC requirements provided that the SHGC for such skylights does not exceed 0.30.

c. “10ci/13” means R-10 continuous insulation (ci) on the interior or exterior of the home wall or R-13 cavity insulation on the interior of the basement wall. “16-15ci/19” means R-15 continuous insulation on the interior or exterior surface of the home wall or R-19 cavity insulation at the interior side of the basement wall. Alternatively, compliance with “16/19” shall be wall “13+5ci” means R-13 cavity insulation on the interior side of the basement wall plus R-5 continuous insulation on the interior or exterior surface of the home wall.

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

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

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

Reason: This proposal does not change the stringency of requirements for basement and crawlspace walls. It does improve clarity and moves an alternative compliance option (13+5ci) from the footnote to the table. The clarification is made by adding a ‘ci’ designator for the continuous insulation components in the table. This is also carried through in the footnote ‘c’. Footnote ‘c’ is further clarified by consistently referring to “wall” rather than in some cases basement and in other cases “home” with no mention of “crawlspace”. The footnote applies to basement and crawlspace walls as noted in the heading of the table columns. Also, the word “surface” is added to clarify that where continuous insulation is used it should be applied to the surface of the foundation wall (and any additional cavity insulation applied to the interior side of the continuous insulation). This is necessary to avoid poor practice that can lead to moisture problems. Where foam sheathing is placed directly on the foundation wall surface it can help prevent moisture problems.

Cost Impact: The code change proposal will not increase or decrease the cost of construction.

The proposal is a non-technical clarification that does not change stringency of requirements.
Proponent: Lauren Urbanek, representing Natural Resources Defense Council (lurbanek@nrdc.org)

2018 International Energy Conservation Code

Revise as follows:

Table R402.1.2 (IRC N1102.1.2)

<table>
<thead>
<tr>
<th>CLIMATEZONE</th>
<th>FENESTRATION-U-FACTOR</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0.40</td>
</tr>
<tr>
<td>2</td>
<td>0.40</td>
</tr>
<tr>
<td>3</td>
<td>0.32</td>
</tr>
<tr>
<td>4 except Marine</td>
<td>0.32</td>
</tr>
<tr>
<td>5 and Marine</td>
<td>0.30</td>
</tr>
<tr>
<td>6</td>
<td>0.30</td>
</tr>
<tr>
<td>7 and 8</td>
<td>0.30</td>
</tr>
</tbody>
</table>

NR = Not Required. For SI: 1 foot = 304.8 mm.

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

b. The fenestration \( U \)-factor column excludes skylights. The SHGC column applies to all glazed fenestration. Exception: In Climate Zones 1 through 3, skylights shall be permitted to be excluded from glazed fenestration SHGC requirements provided that the SHGC for such skylights does not exceed 0.30.

Table R402.1.4 (IRC N1102.1.4)

<table>
<thead>
<tr>
<th>CLIMATEZONE</th>
<th>FENESTRATION-U-FACTOR</th>
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<tbody>
<tr>
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<tr>
<td>3</td>
<td>0.30</td>
</tr>
<tr>
<td>4 except Marine</td>
<td>0.30</td>
</tr>
<tr>
<td>5 and Marine</td>
<td>0.27</td>
</tr>
<tr>
<td>6</td>
<td>0.27</td>
</tr>
<tr>
<td>7 and 8</td>
<td>0.27</td>
</tr>
</tbody>
</table>

Nonfenestration \( U \)-factors shall be obtained from measurement, calculation or an approved source.

Reason: This proposed change to the fenestration \( U \)-factor aligns the IECC with the ENERGY STAR Version 6.0 specification. The ENERGY STAR specification for windows in climate zones 1-4 has been in place since January 1, 2015. The ENERGY STAR specification for windows in climate zones 5-8 has been in place since January 1, 2016. Products that meet the ENERGY STAR standard are widely available and have been for some time. In 2016 – the first year the ENERGY STAR Version 6.0 specification was in effect for all climate zones – ENERGY STAR windows already had an 83% market share. Replacing old windows with ENERGY STAR certified windows lowers household energy bills by an average of 12 percent nationwide. The Environmental Protection Agency performed a cost-effectiveness analysis of Version 6.0 and found it to be cost-effective. That analysis can be found here: http://www.energystar.gov/sites/default/files/ESWDS-ReviewOfCost_EffectivenessAnalysis.pdf

EPA notes that manufacturers can meet the proposed specification for climate zones 5-8 using either double- or triple-pane windows. In general, EPA's data show that double-pane windows that meet the northern climate zone specification are cost effective for consumers.
has received from stakeholders confirms that new glass technologies, improvements in frame performance, and/or better spacer performance can help many product lines meet the proposed Northern Zone criteria with double-pane windows.


Cost Impact: The code change proposal will increase the cost of construction
The code change proposal may increase the cost of construction. Given the level of market penetration of ENERGY STAR products, by the time the 2021 code is adopted many builders will already be meeting the improved requirements. In some limited cases, builders may incur increased costs. EPA estimates that there is a cost of $20 per window to go from the 2009 code requirements to ENERGY STAR Version 6.0. However, the U-factor requirements in the 2018 code are already significantly more stringent than the 2009 code requirements, so we would expect the marginal cost per window to be less.
Proponent: Garrett Tuck, Dehlsen Associates LLC., representing Dehlsen Associates LLC. (gtuck@ecomerittech.com)

2018 International Energy Conservation Code
Revise as follows:

TABLE R402.1.2 (IRC N1102.1.2)
INSULATION AND FENESTRATION REQUIREMENTS BY COMPONENT

<table>
<thead>
<tr>
<th>CLIMATE ZONE</th>
<th>FENESTRATION-UL-FACTOR</th>
<th>SKYLIGHT-UL-FACTOR</th>
<th>GLAZEDFENESTRATION SHGC</th>
<th>CEILING VALUE</th>
<th>WOODFRAME WALL VALUE</th>
<th>MASSWALL VALUE</th>
<th>FLOOR VALUE</th>
<th>BASEMENT WALL VALUE</th>
<th>SLAB R-VALUES DEPTH</th>
<th>CRAWLSPACE WALL VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>NR</td>
<td>0.75</td>
<td>0.25</td>
<td>30</td>
<td>13</td>
<td>3/4</td>
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<tr>
<td>2</td>
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<td>0.25</td>
<td>38</td>
<td>13</td>
<td>4/6</td>
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<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>3</td>
<td>0.32</td>
<td>0.55</td>
<td>0.25</td>
<td>38</td>
<td>20 or 13+5</td>
<td>8/13</td>
<td>19</td>
<td>5/13</td>
<td>0</td>
<td>5/13</td>
</tr>
<tr>
<td>4 except Marine</td>
<td>0.32</td>
<td>0.55</td>
<td>0.40</td>
<td>49</td>
<td>20 or 13+5</td>
<td>8/13</td>
<td>19</td>
<td>10/13</td>
<td>10, 2 ft</td>
<td>10/13</td>
</tr>
<tr>
<td>5 and Marine 4</td>
<td>0.30</td>
<td>0.55</td>
<td>NR</td>
<td>49</td>
<td>20 or 13+5</td>
<td>13/17</td>
<td>19</td>
<td>15/19</td>
<td>10, 2 ft</td>
<td>15/19</td>
</tr>
<tr>
<td>6</td>
<td>0.30</td>
<td>0.55</td>
<td>NR</td>
<td>49</td>
<td>20+3 or 13+10</td>
<td>19/21</td>
<td>38</td>
<td>15/19</td>
<td>10, 4 ft</td>
<td>15/19</td>
</tr>
<tr>
<td>7 and 8</td>
<td>0.30</td>
<td>0.55</td>
<td>NR</td>
<td>49</td>
<td>20+3 or 13+10</td>
<td>19/21</td>
<td>38</td>
<td>15/19</td>
<td>10, 4 ft</td>
<td>15/19</td>
</tr>
</tbody>
</table>

NR = Not Required. For SI: 1 foot = 304.8 mm.

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

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

c. Exception Exceptions:

1. In Climate Zones 1 through 3, skylights shall be permitted to be excluded from glazed fenestration SHGC requirements provided that the SHGC for such skylights does not exceed 0.30.

2. In Climate Zones 1 through 8, skylights shall be permitted to be excluded from glazed fenestration SHGC requirements provided that one of the primary functions is solar thermal collection.

d. “10/13” means R-10 continuous insulation on the interior or exterior of the home or R-13 cavity insulation on the interior of the basement wall. “15/19” means R-15 continuous insulation on the interior or exterior of the home or R-19 cavity insulation at the interior of the basement wall. Alternatively, compliance with “15/19” shall be R-13 cavity insulation on the interior of the basement wall plus R-5 continuous insulation on the interior or exterior of the home.

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

f. There are no SHGC requirements in the Marine Zone.

g. Basement wall insulation is not required in warm-humid locations as defined by Figure R301.1 and Table R301.1.
g. Alternatively, insulation sufficient to fill the framing cavity and providing not less than an $R$-value of R-19.

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

i. Mass walls shall be in accordance with Section R402.2.5. The second $R$-value applies where more than half of the insulation is on the interior of the mass wall.

Reason: Exception: In Climate Zones 1 through 8, skylights shall be permitted to be excluded from glazed fenestration SHGC requirements provided that one of the primary functions is solar thermal collection.

1. Skylight/solar thermal collector combination units have two primary functions, collect thermal energy, and provide light. The amount of thermal energy collection and light transmittance is directly related to the amount of solar irradiance incident on the unit. As the solar irradiance incident on the unit increases, both the thermal energy collection and light transmittance increases. The thermal energy that is collected is transferred to an HTF (heat transfer fluid) and diverted away from the unit into a storage tank. During this process, $G_{IPS}$, the incident solar radiation on the inside pane of the skylight is a function of the $G_{TISR}$ total incident solar radiation and the $G_{SRT}$ solar radiation transmitted ($G_{IPS} = G_{TISR} - G_{SRT}$).

Unlike a normal skylight, skylight/solar thermal collector combination units have the ability to divert the total incident solar radiation away from the skylight and into an HTF where it can be stored and utilized for domestic hot water needs.

2. Currently, there is no test standard for skylight/solar thermal collector combination units to measure how the SHGC of the unit changes over time as a result of the collect.
**Cost Impact:** The code change proposal will not increase or decrease the cost of construction. This proposal is merely an exemption and will not pose any construction cost implications.
2018 International Energy Conservation Code

Revise as follows:

R402.1.4 (IRC N1102.1.4) **U-factor alternative, or F-factor alternative** An assembly with a $U$-factor or $F$-factor equal to or less than that specified in Table R402.1.4 shall be an alternative to the $R$-value in Table R402.1.2.

<table>
<thead>
<tr>
<th>CLIMATEZONE</th>
<th>FENESTRATION-FACTOR</th>
<th>SKYLIGHT-FACTOR</th>
<th>CEILING-FACTOR</th>
<th>FRAMEWALL-FACTOR</th>
<th>MASS WALLU-FACTOR*</th>
<th>FLOORU-FACTOR</th>
<th>BASEMENTWALLU-FACTOR</th>
<th>UNHEATED SLAB $F$-FACTOR</th>
<th>HEATED SLAB $F$-FACTOR</th>
<th>CRAWLSPACE WALLU-FACTOR</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0.50</td>
<td>0.75</td>
<td>0.055</td>
<td>0.084</td>
<td>0.197</td>
<td>0.064</td>
<td>0.360</td>
<td>0.73</td>
<td>1.03</td>
<td>0.477</td>
</tr>
<tr>
<td>2</td>
<td>0.40</td>
<td>0.65</td>
<td>0.050</td>
<td>0.084</td>
<td>0.165</td>
<td>0.064</td>
<td>0.360</td>
<td>0.73</td>
<td>1.03</td>
<td>0.477</td>
</tr>
<tr>
<td>3</td>
<td>0.32</td>
<td>0.55</td>
<td>0.030</td>
<td>0.060</td>
<td>0.064</td>
<td>0.050</td>
<td>0.030</td>
<td>0.73</td>
<td>1.03</td>
<td>0.477</td>
</tr>
<tr>
<td>4 except Marine</td>
<td>0.22</td>
<td>0.55</td>
<td>0.030</td>
<td>0.060</td>
<td>0.064</td>
<td>0.050</td>
<td>0.030</td>
<td>0.73</td>
<td>1.03</td>
<td>0.477</td>
</tr>
<tr>
<td>5 and Marine 4</td>
<td>0.22</td>
<td>0.55</td>
<td>0.030</td>
<td>0.060</td>
<td>0.064</td>
<td>0.050</td>
<td>0.030</td>
<td>0.73</td>
<td>1.03</td>
<td>0.477</td>
</tr>
<tr>
<td>6</td>
<td>0.30</td>
<td>0.55</td>
<td>0.045</td>
<td>0.060</td>
<td>0.064</td>
<td>0.050</td>
<td>0.030</td>
<td>0.73</td>
<td>1.03</td>
<td>0.477</td>
</tr>
<tr>
<td>7 and 8</td>
<td>0.30</td>
<td>0.55</td>
<td>0.045</td>
<td>0.060</td>
<td>0.064</td>
<td>0.050</td>
<td>0.030</td>
<td>0.73</td>
<td>1.03</td>
<td>0.477</td>
</tr>
</tbody>
</table>

- Nonfenestration $U$-factors shall be obtained from measurement, calculation or an approved source.
- Mass walls shall be in accordance with Section R402.2.5. Where more than half the insulation is on the interior, the mass wall $U$-factors shall not exceed 0.17 in Climate Zone 1, 0.14 in Climate Zone 2, 0.12 in Climate Zone 3, 0.087 in Climate Zone 4 except Marine, 0.065 in Climate Zones 5 and Marine 4, and 0.057 in Climate Zones 6 through 8.
- In warm-humid locations as defined by Figure R301.1 and Table R301.1, the basement wall $U$-factor shall not exceed 0.360.
- $F$-factors for heated slabs correspond to the configuration described by footnote (f) of Table R402.1.2

R402.1.5 (IRC N1102.1.5) **Total UA Component performance alternative.** Where the proposed total building thermal envelope $U_A$, the sum of $U$-factor times assembly area, thermal conductance, is less than or equal to the total $U_A$ resulting from multiplying the $U$-factors required total building thermal envelope conductance using factors in Table R402.1.4 by the same assembly area as in the proposed building, the building shall be considered to be in compliance with Table R402.1.2. The $U_A$ calculation shall be performed total thermal conductance shall be shall be determined in accordance with Equation 4-1. Proposed $U$-factors and slab-on-grade $F$-factors shall be determined using a method consistent with the ASHRAE Handbook of Fundamentals and shall include the thermal bridging effects of framing materials. In addition to $U_A$ total thermal conductance compliance, the SHGC requirements shall be met.

$(U_A + F_P) < (U_A + F_P)$ (Equation 4-1)

where:

$U_A = \text{the sum of proposed } U \text{-factors times the assembly areas in the proposed building}$
\[ F_P = \text{the sum of proposed } F\text{-factors times the slab-on-grade perimeter lengths in the proposed building} \]

\[ U_A = \text{the sum of } U\text{-factors in Table R402.1.4 times the same assembly areas as in the proposed building} \]

\[ F_P = \text{the sum of } F\text{-factors in Table R402.1.4 times the slab-on-grade perimeter lengths as in the proposed building} \]

R402.2.10 (IRC N1102.2.10) Slab-on-grade floors. Slab-on-grade floors in contact with the ground with a floor surface less than 12 inches (305 mm) above or below grade shall be insulated in accordance with Table R402.1.2. The insulation shall extend downward from the top of the slab on the outside or inside of the foundation wall. Insulation located below grade shall be extended the distance provided in Table R402.1.2 by any combination of vertical insulation, insulation extending under the slab or insulation extending out from the building. Insulation extending away from the building shall be protected by pavement or by not less than 10 inches (254 mm) of soil. The top edge of the insulation installed between the exterior wall and the edge of the interior slab shall be permitted to be cut at a 45-degree (0.79 rad) angle away from the exterior wall. Slab-edge insulation is not required in jurisdictions designated by the code official as having a very heavy termite infestation.

**Reason:** to clarify how slab-on-grade UA calculations are to be done and provide an approved source for \( F\)-factor data. Although standard calculation procedures (such as ASHRAE's) cover the incorporation of slab conductances, and existing tools (such as REScheck) support slab perimeter insulation tradeoffs in the UA alternative, the code currently gives little direction on slab-on-grade component performance calculations. This clarifies the slab calculation.

This is clarification only; there is no direct impact on energy use.

**Cost Impact:** The code change proposal will not increase or decrease the cost of construction. There is no cost impact since there is no change in requirements. This just clarifies how insulation for slab on grade can be treated in the UA tradeoff calculation.

Proposal # 5667
**Proponent:** Jay Crandell, P.E., ARES Consulting, representing Foam Sheathing Committee of the American Chemistry Council

### 2018 International Energy Conservation Code

Revise as follows:

**TABLE R402.1.2 (IRC N1102.1.2)**

**INSULATION AND FENESTRATION REQUIREMENTS BY COMPONENT**

<table>
<thead>
<tr>
<th>CLIMATEZONE</th>
<th>FENESTRATION-FACCTOR&lt;sup&gt;a&lt;/sup&gt;</th>
<th>SKYLIGHT-FACCTOR&lt;sup&gt;a&lt;/sup&gt;</th>
<th>GLAZED FENESTRATION SHGC&lt;sup&gt;b&lt;/sup&gt;</th>
<th>CEILING VALUE</th>
<th>WOODFRAME WALL-R-VALUE&lt;sup&gt;g&lt;/sup&gt;</th>
<th>MASS WALL-R-VALUE&lt;sup&gt;h&lt;/sup&gt;</th>
<th>FLOOR-R-VALUE&lt;sup&gt;h&lt;/sup&gt;</th>
<th>BASEMENT WALL-R-VALUE&lt;sup&gt;g&lt;/sup&gt;</th>
<th>SLAB R-VALUES&lt;sup&gt;i&lt;/sup&gt;</th>
<th>CRAWLSPACE WALL-R-VALUE&lt;sup&gt;i&lt;/sup&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>NR</td>
<td>0.75</td>
<td>0.25</td>
<td>30</td>
<td>13 or 0&lt;sup&gt;i&lt;/sup&gt;</td>
<td>3/4</td>
<td>13</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>2</td>
<td>0.40</td>
<td>0.65</td>
<td>0.25</td>
<td>38</td>
<td>13 or 0&lt;sup&gt;i&lt;/sup&gt;</td>
<td>4/6</td>
<td>13</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>3</td>
<td>0.32</td>
<td>0.55</td>
<td>0.25</td>
<td>38</td>
<td>20 or 13&lt;sup&gt;i&lt;/sup&gt;</td>
<td>8/13</td>
<td>19</td>
<td>5/13&lt;sup&gt;f&lt;/sup&gt;</td>
<td>0</td>
<td>5/13&lt;sup&gt;f&lt;/sup&gt;</td>
</tr>
<tr>
<td>4 except Marine</td>
<td>0.32</td>
<td>0.55</td>
<td>0.40</td>
<td>49</td>
<td>20 or 13&lt;sup&gt;i&lt;/sup&gt;</td>
<td>8/13</td>
<td>19</td>
<td>10/13&lt;sup&gt;f&lt;/sup&gt;</td>
<td>10/13&lt;sup&gt;f&lt;/sup&gt;</td>
<td></td>
</tr>
<tr>
<td>5 and Marine 4</td>
<td>0.30</td>
<td>0.55</td>
<td>NR</td>
<td>49</td>
<td>20 or 13&lt;sup&gt;i&lt;/sup&gt;</td>
<td>13/17</td>
<td>30&lt;sup&gt;g&lt;/sup&gt;</td>
<td>15/19</td>
<td>10&lt;sup&gt;f&lt;/sup&gt;</td>
<td>15/19</td>
</tr>
<tr>
<td>6</td>
<td>0.30</td>
<td>0.55</td>
<td>NR</td>
<td>49</td>
<td>30 or 20&lt;sup&gt;i&lt;/sup&gt;</td>
<td>10/20</td>
<td>30&lt;sup&gt;g&lt;/sup&gt;</td>
<td>15/19</td>
<td>10&lt;sup&gt;f&lt;/sup&gt;</td>
<td>15/19</td>
</tr>
<tr>
<td>7 and 8</td>
<td>0.30</td>
<td>0.55</td>
<td>NR</td>
<td>49</td>
<td>30 or 20&lt;sup&gt;i&lt;/sup&gt;</td>
<td>19/21</td>
<td>30&lt;sup&gt;g&lt;/sup&gt;</td>
<td>15/19</td>
<td>10&lt;sup&gt;f&lt;/sup&gt;</td>
<td>15/19</td>
</tr>
</tbody>
</table>

NR = Not Required. For SI: 1 foot = 304.8 mm.

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

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

- **Exception:** In Climate Zones 1 through 3, skylights shall be permitted to be excluded from glazed fenestration SHGC requirements provided that the SHGC for such skylights does not exceed 0.30.

- **c.** "10/13" means R-10 continuous insulation on the interior or exterior of the home or R-13 cavity insulation on the interior of the basement wall. "15/19" means R-15 continuous insulation on the interior or exterior of the home or R-19 cavity insulation at the interior of the basement wall. Alternatively, compliance with “15<sup>i</sup>/19<sup>i</sup>” shall be R-13 cavity insulation on the interior of the basement wall plus R-5 continuous insulation on the interior or exterior of the home.

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

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

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

- **g.** Alternatively, insulation sufficient to fill the framing cavity and providing not less than an R-value of R-19.
Reason: This proposal does not change the stringency of insulation requirements for wood frame walls. The intent of this proposal is to: (1) include an additional equivalent insulation option for cavity insulation (currently an equivalent cavity insulation only option is missing in Climate Zones 6-8) and (2) provide for equivalent continuous insulation only options which are also missing. With the addition of these options, the table provides a simple yet complete set of insulation options for location of insulation on wood frame wall assemblies for each climate zone. This is intended to improve the usefulness of prescriptive options and show the full range of equivalent insulation options (e.g., cavity only, hybrid cavity + continuous, and continuous only). It is also intended to address concerns that the prescriptive table favors certain options over others by excluding viable options in some climate zones. This approach also provides more flexibility to coordinate insulation options with vapor retarder provisions in the building code which vary by climate as well as insulation strategy. With this flexibility, users can more readily choose between insulation options that provide equivalent assembly U-factor (as a minimum requirement of the energy code) yet have different capabilities and functions with respect to comfort, air-tightness, moisture control, thermal bridging mitigation, and other factors that are important to an overall code-compliant wall assembly. The thermal equivalency of the proposed options is demonstrated in the assembly U-factor analysis tables that follow.

R0+10 option:

Climate Zone 1 and 2 U-Factor Calculation Spreadsheet

<table>
<thead>
<tr>
<th>Wall Thermal Resistance by Component</th>
<th>2 x 4 Wall R-0 + R8.5ci</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>R-value Cavity Path</td>
</tr>
<tr>
<td>Wall - Outside Winter Air Film^A</td>
<td>0.17</td>
</tr>
<tr>
<td>Siding - Vinyl^A</td>
<td>0.62</td>
</tr>
</tbody>
</table>
### Wall Thermal Resistance by Component

<table>
<thead>
<tr>
<th>Component</th>
<th>R-0 + R13.2ci</th>
<th>R-value Cavity Path</th>
<th>R-value Stud Path</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wall - Outside Winter Air Film</td>
<td>0.17</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Siding - Vinyl</td>
<td>0.62</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Continuous Insulation</td>
<td>13.2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>OSB - 7/16&quot;</td>
<td>0.62</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SPF Stud/Cavity Insulation</td>
<td>0</td>
<td>4.375</td>
<td></td>
</tr>
<tr>
<td>1/2 Drywall</td>
<td>0.45</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Inside Air Film</td>
<td>0.68</td>
<td></td>
<td></td>
</tr>
<tr>
<td>16&quot; o.c. Framing Factor</td>
<td>75%</td>
<td>25%</td>
<td></td>
</tr>
</tbody>
</table>

### Total Wall R-Values

- **Wall - Outside Winter Air Film**: 0.17
- **Siding - Vinyl**: 0.62
- **Continuous Insulation**: 13.2
- **OSB - 7/16"**: 0.62
- **SPF Stud/Cavity Insulation**: 0 + 4.375
- **1/2 Drywall**: 0.45
- **Inside Air Film**: 0.68
- **16" o.c. Framing Factor**: 75% 25%

**Total Wall R-Values**: 15.74 20.12

**Assembly U-Factor**: 0.060

---

**NOTE**: R-0 + R13.2ci is rounded to R-0 + R15ci to align with current convention for continuous insulation R-values in Table R402.1.1.
NOTE: As shown in the calculation above, the R-30 cavity insulation only wall is dependent on thickness of framing (2x8) to satisfy the required maximum U-factor of 0.045. This is because the R-value of the studs (framing path) has an important effect on the overall effective R-value or U-factor of the assemblies with cavity insulation only. Where a 2x6 wall is used, R-38 insulation would be required because a 2x6 stud has a lower R-value than a 2x8 stud and, consequently, more cavity insulation R-value is needed to make up the difference (even though the cavity depth of a 2x6 wall is smaller). This is demonstrated in the table below. While R-38 insulation in a 2x6 wall cavity is possible, it can only be done with a limited selection of cavity insulation material with a 6.9 R/in or greater (i.e., closed cell spray foam). For this reason the proposal uses the R-30 (2x8) option which is more inclusive of various cavity insulation materials having an R-4.1/in or greater. Other options include combinations of cavity insulation materials that add up to R30 (e.g., flash and batt) or double-stud walls that can comply through the U-factor approach.

Climate Zone 6, 7 and 8 U-Factor Calculation Spreadsheet

<table>
<thead>
<tr>
<th>Wall Thermal Resistance by Component</th>
<th>2 x 6 Wall R-38+0ci</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>R-value Cavity Path</td>
</tr>
<tr>
<td>Wall - Outside Winter Air Film^A</td>
<td>0.17</td>
</tr>
<tr>
<td>Siding - Vinyl ^A</td>
<td>0.62</td>
</tr>
<tr>
<td>Continuous Insulation</td>
<td>0</td>
</tr>
<tr>
<td>OSB - 7/16&quot; ^A</td>
<td>0.62</td>
</tr>
<tr>
<td>SPF Stud/Cavity Insulation</td>
<td>38</td>
</tr>
<tr>
<td>1/2 Drywall ^A</td>
<td>0.45</td>
</tr>
<tr>
<td>Inside Air Film ^A</td>
<td>0.68</td>
</tr>
<tr>
<td>16&quot; o.c. Framing Factor ^A</td>
<td>75%</td>
</tr>
<tr>
<td>Total Wall R-Values</td>
<td>40.54</td>
</tr>
<tr>
<td>Assembly U-Factor</td>
<td>0.045</td>
</tr>
</tbody>
</table>

^A 2009 ASHRAE Handbook of Fundamentals

R0 + 20 option:

Climate Zone 6, 7 and 8 U-Factor Calculation Spreadsheet

<table>
<thead>
<tr>
<th>Wall Thermal Resistance by Component</th>
<th>2 x 4 Wall R-0 + R18.7ci</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>R-value Cavity Path</td>
</tr>
<tr>
<td>Wall - Outside Winter Air Film^A</td>
<td>0.17</td>
</tr>
<tr>
<td>Siding - Vinyl ^A</td>
<td>0.62</td>
</tr>
<tr>
<td>Continuous Insulation</td>
<td>18.7</td>
</tr>
<tr>
<td>OSB - 7/16&quot; ^A</td>
<td>0.62</td>
</tr>
<tr>
<td>SPF Stud/Cavity Insulation</td>
<td>0</td>
</tr>
<tr>
<td>1/2 Drywall ^A</td>
<td>0.45</td>
</tr>
<tr>
<td>Inside Air Film ^A</td>
<td>0.68</td>
</tr>
<tr>
<td>16&quot; o.c. Framing Factor ^A</td>
<td>75%</td>
</tr>
<tr>
<td>Total Wall R-Values</td>
<td>21.24</td>
</tr>
<tr>
<td>Assembly U-Factor</td>
<td>0.045</td>
</tr>
</tbody>
</table>

^A 2009 ASHRAE Handbook of Fundamentals

NOTE: R-0 + R18.7ci is rounded to R-0 + R20ci to align with current convention for continuous insulation R-values in Table R402.1.1.

Cost Impact: The code change proposal will not increase or decrease the cost of construction.
The proposal merely provides additional equivalent options for compliance to ensure no one approach or insulation material or its location on or in an assembly is preferentially treated over another in any of the climate zones.
**RE28-19**  
IECC: TABLE R402.1.2 (IRC N1102.1.2)

**Proponent:** John Woestman, representing Extruded Polystyrene Foam Association (jwoestman@kellencompany.com)

**2018 International Energy Conservation Code**

Revise as follows:

![Image](image.png)

**TABLE R402.1.2 (IRC N1102.1.2)**  
INSULATION AND FENESTRATION REQUIREMENTS BY COMPONENT

<table>
<thead>
<tr>
<th>CLIMATEZONE</th>
<th>FENESTRATION U-FACTOR</th>
<th>SKYLIGHT U-FACTOR</th>
<th>GLAZED FENESTRATION SHGC&lt;sup&gt;h&lt;/sup&gt;</th>
<th>CEILING VALUE</th>
<th>WOODFRAME WALL R-VALUE</th>
<th>MASS WALL R-VALUE&lt;sup&gt;h&lt;/sup&gt;</th>
<th>FLOOR R-VALUE</th>
<th>BASEMENT WALL R-VALUE</th>
<th>CRAWLSPACE WALL R-VALUE</th>
<th>SLAB&lt;sup&gt;R&lt;/sup&gt;-VALUE DEPTH</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>NR</td>
<td>0.75</td>
<td>0.25</td>
<td>30</td>
<td>13</td>
<td>3/4</td>
<td>13</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>2</td>
<td>0.40</td>
<td>0.65</td>
<td>0.25</td>
<td>36</td>
<td>13</td>
<td>4/6</td>
<td>13</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>3</td>
<td>0.32</td>
<td>0.55</td>
<td>0.25</td>
<td>36</td>
<td>20 or 13&lt;sup&gt;a&lt;/sup&gt; 13&lt;sup&gt;b&lt;/sup&gt;</td>
<td>8/13</td>
<td>19</td>
<td>5&lt;sup&gt;c&lt;/sup&gt; 50&lt;sup&gt;d&lt;/sup&gt; or 13&lt;sup&gt;e&lt;/sup&gt;</td>
<td>5&lt;sup&gt;c&lt;/sup&gt; 50&lt;sup&gt;d&lt;/sup&gt; or 13&lt;sup&gt;e&lt;/sup&gt;</td>
<td></td>
</tr>
<tr>
<td>4 except Marine</td>
<td>0.32</td>
<td>0.55</td>
<td>0.40</td>
<td>49</td>
<td>20 or 13&lt;sup&gt;a&lt;/sup&gt; 13&lt;sup&gt;b&lt;/sup&gt;</td>
<td>8/13</td>
<td>19</td>
<td>40&lt;sup&gt;f&lt;/sup&gt; 10&lt;sup&gt;i&lt;/sup&gt; or 13&lt;sup&gt;j&lt;/sup&gt;</td>
<td>40&lt;sup&gt;f&lt;/sup&gt; 10&lt;sup&gt;i&lt;/sup&gt; or 13&lt;sup&gt;j&lt;/sup&gt;</td>
<td></td>
</tr>
<tr>
<td>5 and Marine</td>
<td>0.30</td>
<td>0.55</td>
<td>NR</td>
<td>49</td>
<td>20 or 13&lt;sup&gt;a&lt;/sup&gt; 13&lt;sup&gt;b&lt;/sup&gt;</td>
<td>13/17</td>
<td>30&lt;sup&gt;k&lt;/sup&gt;</td>
<td>10&lt;sup&gt;n&lt;/sup&gt; 15 or 19</td>
<td>10&lt;sup&gt;n&lt;/sup&gt; 2 ft</td>
<td>10&lt;sup&gt;n&lt;/sup&gt; 2 ft</td>
</tr>
<tr>
<td>6</td>
<td>0.30</td>
<td>0.55</td>
<td>NR</td>
<td>49</td>
<td>20 or 13&lt;sup&gt;a&lt;/sup&gt; 13&lt;sup&gt;b&lt;/sup&gt;</td>
<td>15/20</td>
<td>30&lt;sup&gt;k&lt;/sup&gt;</td>
<td>15 or 19</td>
<td>10&lt;sup&gt;n&lt;/sup&gt; 15 or 19</td>
<td>10&lt;sup&gt;n&lt;/sup&gt; 4 ft</td>
</tr>
<tr>
<td>7 and 8</td>
<td>0.30</td>
<td>0.55</td>
<td>NR</td>
<td>49</td>
<td>20 or 13&lt;sup&gt;a&lt;/sup&gt; 13&lt;sup&gt;b&lt;/sup&gt;</td>
<td>19/21</td>
<td>30&lt;sup&gt;k&lt;/sup&gt;</td>
<td>10&lt;sup&gt;n&lt;/sup&gt; 15 or 19</td>
<td>10&lt;sup&gt;n&lt;/sup&gt; 4 ft</td>
<td>10&lt;sup&gt;n&lt;/sup&gt; 4 ft</td>
</tr>
</tbody>
</table>

NR = Not Required. For SI: 1 foot = 304.8 mm.

a. R-values are minimums. U-factors and SHGC are maximums. Where insulation is installed in a cavity that is less than the label or design thickness of the insulation, the installed R-value of the insulation shall be not less than the R-value specified in the table.
b. The fenestration U-factor column excludes skylights. The SHGC column applies to all glazed fenestration.

c. "10<sup>f</sup>/50<sup>i</sup> or 13<sup>j</sup>" means R-10 R-5 continuous insulation<sup>h</sup> on the interior or exterior of the home wall or R-13 cavity insulation on the interior of the basement wall or R-13 cavity insulation at the interior of the basement wall. Alternatively, compliance with "15<sup>k</sup>/15 or 19<sup>n</sup>" shall be R-13 cavity insulation on the interior of the basement wall plus in addition to R-5 continuous insulation on the interior or exterior of the home wall.
d. R-5 continuous insulation shall be provided under the full slab area of a heated slab in addition to the required slab edge insulation R-value for slabs, as indicated in the table. The slab edge insulation for heated slabs shall not be required to extend below the slab.
e. There are no SHGC requirements in the Marine Zone.

---

*Notes:

- **SHGC**: Solar Heat Gain Coefficient
- **U-factor**: Thermal Transmittance Value
Reason: This proposal is a clarification of insulation requirements in relation to cavity and continuous insulation applications. This proposal is intended to clarify compliance with Section R402.1.3. In Table R402.1.2, “ci” is inserted wherever continuous insulation is a prescriptive requirement and / or option. Also, the “+” in several cells is replaced with “&” to more appropriately indicate the continuous insulation (ci), along with the cavity insulation, are both required where the CZ requires both. In footnote “c” replacing “and” with “in addition to” to clearly communicate in these situations both cavity insulation and continuous insulation are required.

In the basement and crawl space wall columns, the “/” is replace with “or” to clearly communicate either is acceptable (ci or cavity insulation).

Also, suggesting a bit of cleanup in footnote “c”. Footnote “c” is used for Basement Wall R-value and for Crawl Space Wall R-value. Use of “basement” in the footnote is not quite accurate since this footnote applies equally to basement or crawlspace walls. And, use of “home” is too broad. It seems the use of “wall” is better than the current text. And, in footnote “c” replacing “and” with “in addition to” to clearly communicate in these situations both cavity insulation and continuous insulation are required.

In the crawlspace wall column, inserting footnote “f” similar to where footnote “f” is placed in the basement wall column, and modifying footnote “f” to include crawlspace walls. It seems logical that crawlspace wall insulation would be required – or not required – per the same criteria as basement walls.

Cost Impact: The code change proposal will not increase or decrease the cost of construction. There should be no cost implications as no technical changes are intended.

However, if adding footnote “f” to the crawlspace wall column is a technical change, this proposal would decrease the cost of construction.

Proposal # 5233
RE29-19

IECC: TABLE R402.1.2 (IRC N1102.1.2), TABLE R402.1.4 (IRC N1102.1.4)

Proponent: William Fay, Energy-Efficient Codes Coalition, representing Energy-Efficient Codes Coalition (bfay@ase.org); Daniel Bresette, Alliance to Save Energy, representing Alliance to Save Energy (dbresette@ase.org); Maureen Guttman, BCAP-IBTS, representing BCAP-IBTS (mguttman@bcapcodes.org); Harry Misuriello, American Council for an Energy-Efficient Economy, representing American Council for an Energy-Efficient Economy (misuriello@verizon.net)

2018 International Energy Conservation Code
Revise as follows:

TABLE R402.1.2 (IRC N1102.1.2)
INSULATION AND FENESTRATION REQUIREMENTS BY COMPONENT

<table>
<thead>
<tr>
<th>CLIMATEZONE</th>
<th>FENESTRATION U-FACTOR</th>
<th>SKYLIGHT U-FACTOR</th>
<th>GLAZED FENESTRATION SHGC</th>
<th>CEILING U-FACTOR</th>
<th>WALL U-FACTOR R-VALUE</th>
<th>FLOOR U-FACTOR R-VALUE</th>
<th>BASEMENT WALL U-FACTOR</th>
<th>SLAB R-VALUE DEPTH</th>
<th>CRAWLSPACE WALL U-FACTOR</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>NR</td>
<td>0.75</td>
<td>0.25</td>
<td>30</td>
<td>3/4</td>
<td>13</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>2</td>
<td>0.40</td>
<td>0.65</td>
<td>0.25</td>
<td>38</td>
<td>13</td>
<td>4/6</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>3</td>
<td>0.32</td>
<td>0.55</td>
<td>0.25</td>
<td>38</td>
<td>20 or 13/5</td>
<td>13/15</td>
<td>0</td>
<td>5/13</td>
<td>0</td>
</tr>
<tr>
<td>4 except Marine</td>
<td>0.32</td>
<td>0.55</td>
<td>0.25</td>
<td>20 or 13/5</td>
<td>13/15</td>
<td>10/13</td>
<td>0</td>
<td>10/13</td>
<td>0</td>
</tr>
<tr>
<td>5 and Marine 4</td>
<td>0.30</td>
<td>0.55</td>
<td>NR</td>
<td>19</td>
<td>10/13</td>
<td>10/13</td>
<td>0</td>
<td>10/13</td>
<td>0</td>
</tr>
<tr>
<td>6</td>
<td>0.30</td>
<td>0.55</td>
<td>0.25</td>
<td>19</td>
<td>10/13</td>
<td>10/13</td>
<td>0</td>
<td>10/13</td>
<td>0</td>
</tr>
<tr>
<td>7 and 8</td>
<td>0.30</td>
<td>0.55</td>
<td>0.25</td>
<td>19</td>
<td>10/13</td>
<td>10/13</td>
<td>0</td>
<td>10/13</td>
<td>0</td>
</tr>
</tbody>
</table>

NR = Not Required. For SI: 1 foot = 304.8 mm.
a. R-values are minimums. U-factors and SHGC are maximums. Where insulation is installed in a cavity that is less than the label or design thickness of the insulation, the installed R-value of the insulation shall be not less than the R-value specified in the table.
b. The fenestration U-factor column excludes skylights. The SHGC column applies to all glazed fenestration.

Exception: In Climate Zones 1 through 3, skylights shall be permitted to be excluded from glazed fenestration SHGC requirements provided that the SHGC for such skylights does not exceed 0.3.

c. “10/13” means R-10 continuous insulation on the interior or exterior of the home or R-13 cavity insulation on the interior or exterior of the basement wall. “15/19” means R-15 continuous insulation on the interior or exterior of the home or R-19 cavity insulation at the interior of the basement wall. Alternatively, compliance with “15/19” shall be R-13 cavity insulation on the interior of the basement wall plus R-5 continuous insulation on the interior or exterior of the home.
d. R-5 insulation shall be provided under the full slab area of a heated slab in addition to the required slab edge insulation R-5 value for slabs, as indicated in the table. The slab edge insulation for heated slabs shall not be required to extend below the slab.
e. There are no SHGC requirements in the Marine Zone.
f. Basement wall insulation is not required in warm-humid locations as defined by Figure R301.1 and Table R301.1.
g. Alternatively, insulation sufficient to fill the framing cavity and providing not less than an R-value of R-19.
h. The first value is cavity insulation, the second value is continuous insulation. Therefore, as an example, “13+5” means R-13 cavity insulation plus R-5 continuous insulation.
i. Mass walls shall be in accordance with Section R402.2.5. The second R-value applies where more than half of the insulation is on the interior of the mass wall.

TABLE R402.1.4 (IRC N1102.1.4)
EQUIVALENT U-FACTORs

<table>
<thead>
<tr>
<th>CLIMATEZONE</th>
<th>FENESTRATION U-FACTOR</th>
<th>SKYLIGHT U-FACTOR</th>
<th>CEILING U-FACTOR</th>
<th>FRAMEWALL U-FACTOR</th>
<th>MASS WALL U-FACTOR</th>
<th>FLOOR U-FACTOR</th>
<th>BASEMENT WALL U-FACTOR</th>
<th>CRAWLSPACE WALL U-FACTOR</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0.50</td>
<td>0.75</td>
<td>0.035</td>
<td>0.084</td>
<td>0.197</td>
<td>0.064</td>
<td>0.360</td>
<td>0.477</td>
</tr>
<tr>
<td>2</td>
<td>0.40</td>
<td>0.65</td>
<td>0.030</td>
<td>0.084</td>
<td>0.165</td>
<td>0.064</td>
<td>0.360</td>
<td>0.477</td>
</tr>
<tr>
<td>3</td>
<td>0.32</td>
<td>0.55</td>
<td>0.030</td>
<td>0.060</td>
<td>0.098</td>
<td>0.047</td>
<td>0.091</td>
<td>0.136</td>
</tr>
<tr>
<td>4 except Marine</td>
<td>0.32</td>
<td>0.55</td>
<td>0.026</td>
<td>0.050</td>
<td>0.098</td>
<td>0.047</td>
<td>0.059</td>
<td>0.065</td>
</tr>
</tbody>
</table>
5 and Marine 4 | 0.30 | 0.55 | 0.026 | 0.060 | 0.045 | 0.082 | 0.033 | 0.050 | 0.055
---|---|---|---|---|---|---|---|---|---
6 | 0.30 | 0.55 | 0.026 | 0.060 | 0.045 | 0.060 | 0.033 | 0.050 | 0.055
7 and 8 | 0.30 | 0.55 | 0.026 | 0.060 | 0.045 | 0.057 | 0.028 | 0.050 | 0.055

a. Nonfenestration $U$-factors shall be obtained from measurement, calculation or an approved source.

b. Mass walls shall be in accordance with Section R402.2.5. Where more than half the insulation is on the interior, the mass wall $U$-factors shall not exceed 0.17 in Climate Zone 1, 0.14 in Climate Zone 2, 0.12 in Climate Zone 3, 0.087 in Climate Zone 4 except Marine, 0.065 in Climate Zone 5 and Marine 4, and 0.057 in Climate Zones 6 through 8.

c. In warm-humid locations as defined by Figure R301.1 and Table R301.1, the basement wall $U$-factor shall not exceed 0.360.

**Reason:** The purpose of this code change proposal is to upgrade and strengthen the requirements for wall insulation in climate zones 4 and 5 by making the requirements equal to the current requirements in climate zone 6. This will make homes more comfortable for occupants and reduce energy costs over the life of the building.

Because wall insulation is most cost-effectively installed during construction, walls should be insulated to the maximum cost-effective levels at that time, rather than expecting homeowners to upgrade them at some later date. This approach is consistent with the intent of the IECC (R101.3) to “regulate the design and construction of buildings for the effective use and conservation of energy over the useful life of each building.”

The proposed improvements represent the next step in commonly-available products and construction practices. Using DOE’s cost-effectiveness methodology, we found these R-values to offer substantial net life cycle savings and be clearly cost-effective for the homeowner/consumer in both climate zones:

<table>
<thead>
<tr>
<th>Climate Zone</th>
<th>Annual Energy Cost Savings</th>
<th>Present Value Life Cycle Benefit</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>5.7%</td>
<td>$1,605</td>
</tr>
<tr>
<td>5</td>
<td>4.3%</td>
<td>$1,152</td>
</tr>
</tbody>
</table>


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

Requiring more insulation will increase the cost of construction, but the resulting energy and cost savings will recoup the initial costs and will continue to benefit consumers over the useful life of the home.
Proponent: Ben Edwards, representing Mathis Consulting Co. (ben@mathisconsulting.com)

2018 International Energy Conservation Code
Revise as follows:

TABLE R402.1.2 (IRC N1102.1.2)

INSULATION AND FENESTRATION REQUIREMENTS BY COMPONENT

Portions of table not shown remain unchanged.

<table>
<thead>
<tr>
<th>CLIMATEZONE</th>
<th>GLAZED FENESTRATION SHGC&lt;sup&gt;a,b&lt;/sup&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>4 except Marine</td>
<td>0.40 0.35</td>
</tr>
</tbody>
</table>

NR = Not Required. For SI: 1 foot = 304.8 mm.

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

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

  **Exception:** In Climate Zones 1 through 3, skylights shall be permitted to be excluded from glazed fenestration SHGC requirements provided that the SHGC for such skylights does not exceed 0.30.

- “10/13” means R-10 continuous insulation on the interior or exterior of the home or R-13 cavity insulation on the interior of the basement wall. “15/19” means R-15 continuous insulation on the interior or exterior of the home or R-19 cavity insulation at the interior of the basement wall. Alternatively, compliance with “15/19” shall be R-13 cavity insulation on the interior of the basement wall plus R-5 continuous insulation on the interior or exterior of the home.

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

- There are no SHGC requirements in the Marine Zone.

- Basement wall insulation is not required in warm-humid locations as defined by Figure R301.1 and Table R301.1.

- Alternatively, insulation sufficient to fill the framing cavity and providing not less than an R-value of R-19.

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

- Mass walls shall be in accordance with Section R402.2.5. The second R-value applies where more than half of the insulation is on the interior of the mass wall.

**Reason:** In 2017 the US Environmental Protection Agency (EPA) reevaluated their methodology for determining what fenestration products are available to consumers in a Window Technology Pathways white paper (see bibliography). Components from the National Fenestration Rating Council Certified Product Directory were categorized, and prevalence of performance technologies were reported. Of concern for this proposal, SHGC performance was placed into 4 bins:

“To understand the distribution of SHGC at different U-factors, EPA grouped products into four SHGC bins that correspond to the Version 6.0 ENERGY STAR criteria: **High** SHGC (>0.40), **Medium** SHGC (0.26 – 0.40), **Low** SHGC (0.20 – 0.25), and **Very Low** SHGC (<0.20). The SHGC bins provide another dimension to analyze the performance of different pathways.” -EPA pg.6 (PDF pg.8, emphasis added)

In the Windows Pathway Analysis Workbook the summarized data show that, for a U-factor range of 0.28 - 0.32 (i.e., the typical market windows used to comply with the IECC-2018 climate zone 4 requirement of U=0.32) about 56% of the products are less than SHGC=0.25, 92% are less than SHGC=0.40, and only 8% would be considered “High SHGC” (SHGC > 0.40). Again, these are all of the window options in NFRC’s CPD, including niche/specialized function windows, which never would be used for prescriptive compliance. Further, the DOE-Field-Study-SHGC-snapshot.jpg (from the DOE Field Study, an investigation into actual construction practices, see bibliography), surveyed states and found that windows, almost exclusively, were under the SHGC=0.35 proposed value. It is important to note that all states surveyed (other than NC, using the NCECC2012; and MD, using the IECC2012) had no SHGC requirement in climate zone 4.

The Workbook is found at:

At
The relevant information is on the “Summary Tables” tab.

To be clear: Even in jurisdictions with no SHGC requirement, almost no windows performed worse than this proposed value, which is the almost exclusive majority of readily available windows. The prescriptive compliance path in the new, 2021 IECC should, at least, represent the standard practice of installed window performance, with an SHGC requirement at 0.35. Because meeting this minimal requirement already is standard practice, this proposal should not be considered to increase the cost of construction.

Bibliography:

Cost Impact: The code change proposal will increase the cost of construction
The selection of “increase the cost of construction” is a technicality. Please see reason statement.
Revised to: TABLE R402.1.2, R402.2.1, R402.2.2

Proponent: Matthew Brown, APA-The Engineered Wood Association, representing APA-The Engineered Wood Association (matthew.brown@apawood.org); Loren Ross, American Wood Council, representing American Wood Council (LRoss@awc.org)

2018 International Energy Conservation Code

Revised as follows:

**TABLE R402.1.2**

**INSULATION AND FENESTRATION REQUIREMENTS BY COMPONENT**

<table>
<thead>
<tr>
<th>CLIMATEZONE</th>
<th>FENESTRATIONU-FACTOR</th>
<th>SKYLIGHTU-FACTOR</th>
<th>GLAZEDFENESTRATION SHGC</th>
<th>CEILING VALUE</th>
<th>WOODFRAME WALLR-VALUE</th>
<th>MASS WALLR-VALUE</th>
<th>FLOORR-VALUE</th>
<th>BASEMENT WALLR-VALUE</th>
<th>SLABR-VALUE DEPTH</th>
<th>CRAWLSPACE WALLR-VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>6</td>
<td>0.30</td>
<td>0.55</td>
<td>NR</td>
<td>49</td>
<td>20 or 20+5 or 13+10</td>
<td>15/20</td>
<td>30</td>
<td>15/19</td>
<td>10, 4 ft</td>
<td>15/19</td>
</tr>
<tr>
<td>7 and 8</td>
<td>0.30</td>
<td>0.55</td>
<td>NR</td>
<td>49</td>
<td>20+5 or 13+10</td>
<td>19/21</td>
<td>38</td>
<td>15/19</td>
<td>10, 4 ft</td>
<td>15/19</td>
</tr>
</tbody>
</table>

NR = Not Required. For SI: 1 foot = 304.8 mm.

a. R-values are minimums. U-factors and SHGC are maximums. Where insulation is installed in a cavity that is less than the label or design thickness of the insulation, the installed R-value of the insulation shall be not less than the R-value specified in the table.
b. The fenestration U-factor column excludes skylights. The SHGC column applies to all glazed fenestration.

c. Exception: In Climate Zones 1 through 3, skylights shall be permitted to be excluded from glazed fenestration SHGC requirements provided that the SHGC for such skylights does not exceed 0.30.
d. "10/13" means R-10 continuous insulation on the interior or exterior of the home or R-13 cavity insulation on the interior of the basement wall. "15/19" means R-15 continuous insulation on the interior or exterior of the home or R-19 cavity insulation at the interior of the basement wall. Alternatively, compliance with "15/19" shall be R-13 cavity insulation on the interior of the basement wall plus R-5 continuous insulation on the interior or exterior of the home.
e. R-5 insulation shall be provided under the full slab area of a heated slab in addition to the required slab edge insulation R-value for slabs, as indicated in the table. The slab edge insulation for heated slabs shall not be required to extend below the slab.
f. There are no SHGC requirements in the Marine Zones.
g. Alternatively, insulation sufficient to fill the framing cavity and providing not less than an R-value of R-19.
h. The first value is cavity insulation, the second value is continuous insulation. Therefore, as an example, "13+5" means R-13 cavity insulation plus R-5 continuous insulation.
R402.2.1 (IRC N1102.1.1) Ceilings with attic spaces. Where Section R402.1.2 requires R-38 insulation in the ceiling, installing R-30 over 100 percent of the ceiling area requiring insulation shall satisfy the requirement for R-38 wherever the full height of uncompressed R-30 insulation extends over the wall top plate at the eaves. Where Section R402.1.2 requires R-49 insulation in the ceiling, installing R-38 over 100 percent of the ceiling area requiring insulation shall satisfy the requirement for R-49 insulation wherever the full height of uncompressed R-38 insulation extends over the wall top plate at the eaves. Where Section R402.1.2 requires R-60 insulation in the ceiling, installing R-49 over 100 percent of the ceiling area requiring insulation shall satisfy the requirement for R-60 insulation wherever the full height of uncompressed R-49 insulation extends over the wall top plate at the eaves. This reduction shall not apply to the U-factor alternative approach in Section R402.1.4 and the Total UA alternative in Section R402.1.5.

R402.2.2 (IRC N1102.2.2) Ceilings without attic spaces. Where Section R402.1.2 requires insulation R-values greater than R-30 but less than or equal to R-49 in the ceiling and the design of the roof/ceiling assembly does not allow sufficient space for the required insulation, the minimum required insulation R-value for such roof/ceiling assemblies shall be R-30. Where Section R402.1.2 requires insulation greater than R-49 in the ceiling and the design of the roof/ceiling assembly does not allow sufficient space for the required insulation, the required insulation R-value for such roof/ceiling assemblies shall be R-38. Insulation shall extend over the top of the wall plate to the outer edge of such plate and shall not be compressed. This reduction of insulation from the requirements of Section R402.1.2 shall be limited to 500 square feet (46 m²) or 20 percent of the total insulated ceiling area, whichever is less. This reduction shall not apply to the U-factor alternative approach in Section R402.1.4 and the Total UA alternative in Section R402.1.5.

Reason: This proposal provides a necessary prescriptive cavity-only wall insulation option for builders and building officials in Climate Zones 6-8. It combines a minimum R-23 wood frame wall R-value with better performing windows (U=0.28) and increased ceiling insulation (R-60), such that equivalent energy performance is achieved. It also modifies Sec. R402.2.1 (Ceilings with attic spaces) and Sec. R402.2.2 (Ceilings without attic spaces) to address framing considerations where R-60 ceiling insulation is required. The proposed R-23 wall cavity insulation level is compatible with 2x6 framing using a variety of cavity insulation types, including several types of batt insulation products and blown-in insulation systems. Note that this proposal does not modify the two existing continuous insulation assemblies.
already listed in Table R402.1.2, nor does it affect the U-factors in Table R402.1.4.

The proposed change provides better energy efficiency performance than the 2018 IECC as shown by both an energy simulation analysis and a Total UA analysis. Both analyses used the U.S. Department of Energy Single Family Prototype for Determining the Cost Effectiveness of the 2018 IECC for house characteristics and square footage The simulated performance analysis also used the U-factors and modeling guidelines in Sections R405.5.2(1) and R405.5.2(2) of the 2018 IECC for modeling the base or reference home.

1. Table R402.1.2 - Simulated Energy Performance Analysis

<table>
<thead>
<tr>
<th>Option</th>
<th>Description:</th>
<th>MMBTU/YR</th>
<th>Energy Cost YR</th>
<th>% Better</th>
</tr>
</thead>
<tbody>
<tr>
<td>Base</td>
<td>Base 2018 IECC</td>
<td>87.4</td>
<td>$1309.00</td>
<td>0.0%</td>
</tr>
<tr>
<td>Option 2</td>
<td>R-23 wood frame wall, U-.28 vertical fenestration, R-60 attic</td>
<td>85.9</td>
<td>$1292.00</td>
<td>0.3%</td>
</tr>
</tbody>
</table>

1. Whole Home MMBTU/YR
2. Whole Home Energy Cost/YR
3. Square footages and attributes taken from the US DOE Single Family Prototype for Determining the Cost Effectiveness of the 2018 IECC and modeling guidelines in R405.5.2(1) and R405.5.2(2) of the 2018 IECC.

2. Table R402.1.2 - Total Building UA Analysis

<table>
<thead>
<tr>
<th>Option</th>
<th>Description:</th>
<th>Overall U-Factor</th>
<th>% Better</th>
</tr>
</thead>
<tbody>
<tr>
<td>Base</td>
<td>Base 2018 IECC</td>
<td>313</td>
<td>0.0%</td>
</tr>
<tr>
<td>Option 2</td>
<td>R-23 wood frame wall, U-.28 vertical fenestration, R-60 attic</td>
<td>309</td>
<td>1.3%</td>
</tr>
</tbody>
</table>

1. Square footages and attributes taken from the US DOE Single Family Prototype for Determining the Cost Effectiveness of the 2018 IECC.
2. Component U-factors calculated in accordance with the 2015 ASHRAE Handbook of Fundamentals.

New footnote j requires R60 ceiling insulation. This means that Section R402.2.2.1 and R402.2.2.2, which address ceiling insulation to accommodate framing geometry, also need to be modified for consistency.

For R402.2.1, (Ceilings with attic spaces), calculations show that where R-49 insulation covers 100 percent of the ceiling area, including exterior wall plates, at full, uncompressed depth, it provides equivalent performance to R-60 with typical eave edge compression. This proposed change was modeled using both a Total UA analysis and Performance based energy modeling. Both models demonstrate energy savings compared to a home built to the base prescriptive path in Tables R402.1.2 and R402.1.4.

R402.2.1 - Total Building UA Analysis (REScheck):

<table>
<thead>
<tr>
<th>Option</th>
<th>Description:</th>
<th>Overall U-Factor</th>
<th>% Better</th>
</tr>
</thead>
<tbody>
<tr>
<td>Base</td>
<td>Base 2018 IECC</td>
<td>293</td>
<td>0.0%</td>
</tr>
<tr>
<td>option 2</td>
<td>R-49 ceiling with RHT, R-23 wood frame wall, U-.28 fenestration.</td>
<td>290</td>
<td>1.0%</td>
</tr>
</tbody>
</table>

1. Building square footages and characteristics from the U.S department of energy’s single family prototype home for determining the cost effectiveness of the 2018 IECC were used for energy modeling.
2. Component U-Factors used for energy modeling taken from table R402.1.4 of the 2018 IECC.
3. All components not listed, U-factors for energy modeling were taken from table R402.1.4 of the 2018 IECC.

**R402.2.1 - Simulated Energy Performance Analysis:**

<table>
<thead>
<tr>
<th>Option:</th>
<th>Description:</th>
<th>MMBTU/YR</th>
<th>Energy Cost YR</th>
<th>% Better</th>
</tr>
</thead>
<tbody>
<tr>
<td>Base</td>
<td>Base 2018 IECC[^3^,4^]. Code Home: (Includes R-49 attic with Standard trusses, R-20+5 (U-0.45) wood frame walls, and U-0.30 fenestration.)</td>
<td>87.4</td>
<td>$1309.00</td>
<td>0.0%</td>
</tr>
<tr>
<td>R402.2.2-1 Raised Heel Truss (RHT)</td>
<td>Base 2018 IECC[^3^,5^]. Code home using: R-49 ceiling with RHT, R-23 wood frame wall, U-.28 fenestration.</td>
<td>83.0</td>
<td>$1302.00</td>
<td>0.5%</td>
</tr>
</tbody>
</table>

1. Whole Home MMBTU/YR
2. Whole Home Energy Cost/YR
3. Square footages and attributes taken from the US DOE Single Family Prototype for Determining the Cost Effectiveness of the 2018 IECC and modeling guidelines in R405.5.2(1) and R405.5.2(2) of the 2018 IECC.
4. Component U-Factors used for energy modeling taken from table R402.1.4 of the 2018 IECC.
5. All components not listed, U-factors for energy modeling were taken from table R402.1.4 of the 2018 IECC.

Proposed Section R402.2.2 extends the code's existing recognition of a limited area of reduced insulation to accommodate structural limitations, but it also increases the required stringency of the area of reduced insulation where the Section R402.1.2 base ceiling insulation requirement exceeds R-49.

Currently the code permits R-49 required ceiling insulation, for 20 percent of the ceiling area, to be reduced by R-19 to R-30. As proposed, R-60 insulation, for 20 percent of the ceiling area, would be permitted to be reduced by R-22 to R-38. This is effectively an equivalent reduction in allowable stringency.

The proposed changes were modeled using both a Total UA analysis and Performance based energy modeling. Both models demonstrate energy savings when compared to a home built to the base prescriptive path in Tables R402.1.2 and R402.1.4.

**R402.2.2 - Simulated Energy Performance Analysis:**

<table>
<thead>
<tr>
<th>Option:</th>
<th>Description:</th>
<th>MMBTU/YR</th>
<th>Energy Cost YR</th>
<th>% Better</th>
</tr>
</thead>
<tbody>
<tr>
<td>Base</td>
<td>Base 2018 IECC[^3^]</td>
<td>87.4</td>
<td>$1309.00</td>
<td>0.0%</td>
</tr>
<tr>
<td>R402.2.2-2 Vaulted Clg.</td>
<td>R-23 wood framed wall, U-.28 fenestration, R-38 vaulted ceiling-20% attic area.</td>
<td>84.8</td>
<td>$1305.00</td>
<td>0.3%</td>
</tr>
</tbody>
</table>

1[^1^] Whole Home MMBTU/YR
3[^3^] Square footages and attributes taken from the US DOE Single Family Prototype for Determining the Cost Effectiveness of the 2018 IECC and modeling guidelines in R405.5.2(1) and R405.5.2(2) of the 2018 IECC.

**R402.2.2 - Total Building UA Analysis (REScheck):**

<table>
<thead>
<tr>
<th>Option:</th>
<th>Description:</th>
<th>Overall U-Factor</th>
<th>% Better</th>
</tr>
</thead>
<tbody>
<tr>
<td>Base</td>
<td>Base 2018 IECC[^1^]</td>
<td>293</td>
<td>0.0%</td>
</tr>
<tr>
<td>R402.2.2-2 Vaulted Clg.</td>
<td>R-23 wood framed wall, U-.28 fenestration, R-38 vaulted ceiling-20% attic area.</td>
<td>287</td>
<td>2.0%</td>
</tr>
</tbody>
</table>

1[^1^] Square footages and attributes taken from the US DOE Single Family Prototype for Determining the Cost Effectiveness of the 2018 IECC.
Cost Impact: The code change proposal will not increase or decrease the cost of construction. While it has the potential to decrease the cost of construction, the proposal cannot increase construction costs since it merely adds another prescriptive option for builders.
Proponent: William Fay, Energy-Efficient Codes Coalition, representing Energy-Efficient Codes Coalition (bfay@ase.org); Daniel Bresette, Alliance to Save Energy, representing Alliance to Save Energy (dbresette@ase.org); Maureen Guttman, BCAP-IBTS, representing BCAP-IBTS (mguttman@bcapcodes.org); Harry Misuriello, representing American Council for an Energy-Efficient Economy (misuriello@verizon.net)

2018 International Energy Conservation Code

Revise as follows:

Reason: The purpose of this code change proposal is to increase energy savings and improve comfort by upgrading and improving slab insulation requirements for climate zones 3-5. Although most other components of the building thermal envelope have improved in recent years, the slab R-value requirements have not improved in any climate zone since at least 2006. The improved values would produce substantial energy cost savings and life cycle cost benefits in all three climate zones:

<table>
<thead>
<tr>
<th>CLIMATEZONE</th>
<th>FENESTRATION U-FACTOR²</th>
<th>SKYLIGHT U-FACTOR</th>
<th>GLAZED FENESTRATION SHGC</th>
<th>CEILING R-VALUE</th>
<th>WALL R-VALUE</th>
<th>MASSWALL R-VALUE</th>
<th>FLOOR R-VALUE</th>
<th>BASEMENT WALL R-VALUE</th>
<th>SLAB² R-VALUE</th>
<th>CRAWLSPACE WALL R-VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>NR</td>
<td>0.75</td>
<td>0.25</td>
<td>30</td>
<td>12</td>
<td>3/4</td>
<td>10</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>2</td>
<td>0.40</td>
<td>0.65</td>
<td>0.25</td>
<td>38</td>
<td>13</td>
<td>4/5</td>
<td>10</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>3</td>
<td>0.32</td>
<td>0.55</td>
<td>0.25</td>
<td>38</td>
<td>20 or 13+5²</td>
<td>8/13</td>
<td>19</td>
<td>5/13</td>
<td>10</td>
<td>2.5f</td>
</tr>
<tr>
<td>4 exceptMarine</td>
<td>0.32</td>
<td>0.55</td>
<td>0.40</td>
<td>49</td>
<td>20 or 13+5²</td>
<td>8/13</td>
<td>19</td>
<td>10/13</td>
<td>10</td>
<td>4 ft</td>
</tr>
<tr>
<td>5 and Marine</td>
<td>0.30</td>
<td>0.55</td>
<td>NR</td>
<td>49</td>
<td>20 or 13+5²</td>
<td>13/17</td>
<td>30²</td>
<td>15/19</td>
<td>10</td>
<td>4 ft</td>
</tr>
<tr>
<td>6</td>
<td>0.30</td>
<td>0.55</td>
<td>NR</td>
<td>49</td>
<td>20 or 5+13²</td>
<td>15/20</td>
<td>30²</td>
<td>15/19</td>
<td>10</td>
<td>4 ft</td>
</tr>
<tr>
<td>7 and 8</td>
<td>0.30</td>
<td>0.55</td>
<td>NR</td>
<td>49</td>
<td>20 or 5+13²</td>
<td>15/21</td>
<td>30²</td>
<td>15/19</td>
<td>10</td>
<td>4 ft</td>
</tr>
</tbody>
</table>

NR = Not Required. For SI: 1 foot = 304.8 mm.

- R-values are minimums. U-factors and SHGC are maximums. Where insulation is installed in a cavity that is less than the label or design thickness of the insulation, the installed R-value of the insulation shall be not less than the R-value specified in the table.
- The fenestration U-factor column excludes skylights. The SHGC column applies to all glazed fenestration.
- Exception: In Climate Zones 1 through 3, skylights shall be permitted to be excluded from glazed fenestration SHGC requirements provided that the SHGC for such skylights does not exceed 0.30.
- “10/13” means R-10 continuous insulation on the interior or exterior of the home or R-13 cavity insulation on the interior of the basement wall. “15/19” means R-15 continuous insulation on the interior or exterior of the home or R-19 cavity insulation at the interior of the basement wall. Alternatively, compliance with “15/19” shall be R-13 cavity insulation on the interior of the basement wall plus R-5 continuous insulation on the interior or exterior of the home.
- R-5 insulation shall be provided under the full slab area of a heated slab in addition to the required slab edge insulation R-value for slabs, as indicated in the table. The slab edge insulation for heated slabs shall not be required to extend below the slab.
- There are no SHGC requirements in the Marine Zone.
- Basement wall insulation is not required in warm-humid locations as defined by Figure R301.1 and Table R301.1.
- The first value is cavity insulation, the second value is continuous insulation. Therefore, as an example, “13+5” means R-13 cavity insulation plus R-5 continuous insulation.
- Mass walls shall be in accordance with Section R402.2.5. The second R-value applies where more than half of the insulation is on the interior of the mass wall.
Insulation can last for many decades and possibly the full useful life of the building, providing consistent comfort and energy saving benefits over that period, so it is particularly important to capture as much cost-effective energy efficiency as possible at construction. This is consistent with the intent of the IECC (R101.3), which is to “regulate the design and construction of buildings for the effective use and conservation of energy over the useful life of each building.”

**Cost Impact:** The code change proposal will increase the cost of construction
The additional insulation required will add to construction costs. However, our analysis shows that the improved efficiency will produce a clear life cycle benefit to the homeowner.

<table>
<thead>
<tr>
<th>Climate Zone</th>
<th>Annual Energy Cost Savings</th>
<th>Present Value Life Cycle Benefit</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>6.8%</td>
<td>$3,132</td>
</tr>
<tr>
<td>4</td>
<td>2.5%</td>
<td>$1,000</td>
</tr>
<tr>
<td>5</td>
<td>2.2%</td>
<td>$1,076</td>
</tr>
</tbody>
</table>

Proposal # 4109

RE32-19
2018 International Energy Conservation Code

Revised as follows:

**TABLE R402.1.2 (IRC N1102.1.2)**

<table>
<thead>
<tr>
<th>CLIMATEZONE</th>
<th>FENESTRATION U-FACTOR</th>
<th>SKYLIGHT U-FACTOR</th>
<th>GLAZED FENESTRATION SHGC</th>
<th>CEILING U-FACTOR</th>
<th>WALL U-FACTOR</th>
<th>MASS WALL U-FACTOR</th>
<th>FLOOR U-FACTOR</th>
<th>BASEMENT WALL U-FACTOR</th>
<th>SLAB R-VALUE DEPTH</th>
<th>CRAWLSPACE WALL U-FACTOR</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0.50</td>
<td>0.75</td>
<td>0.25</td>
<td>0.035</td>
<td>0.084</td>
<td>0.197</td>
<td>0.064</td>
<td>0.360</td>
<td>0.477</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>0.40</td>
<td>0.65</td>
<td>0.25</td>
<td>0.035</td>
<td>0.084</td>
<td>0.197</td>
<td>0.064</td>
<td>0.360</td>
<td>0.477</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>0.32</td>
<td>0.55</td>
<td>0.25</td>
<td>0.035</td>
<td>0.084</td>
<td>0.197</td>
<td>0.064</td>
<td>0.360</td>
<td>0.477</td>
<td></td>
</tr>
<tr>
<td>4 except Marine</td>
<td>0.32</td>
<td>0.55</td>
<td>0.25</td>
<td>0.035</td>
<td>0.084</td>
<td>0.197</td>
<td>0.064</td>
<td>0.360</td>
<td>0.477</td>
<td></td>
</tr>
</tbody>
</table>

**TABLE R402.1.4 (IRC N1102.1.4)**

<table>
<thead>
<tr>
<th>CLIMATEZONE</th>
<th>FENESTRATION U-FACTOR</th>
<th>SKYLIGHT U-FACTOR</th>
<th>CEILING U-FACTOR</th>
<th>FRAMEWALL U-FACTOR</th>
<th>MASS WALL U-FACTOR</th>
<th>FLOOR U-FACTOR</th>
<th>BASEMENT WALL U-FACTOR</th>
<th>CRAWLSPACE WALL U-FACTOR</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0.50</td>
<td>0.75</td>
<td>0.035</td>
<td>0.084</td>
<td>0.197</td>
<td>0.064</td>
<td>0.360</td>
<td>0.477</td>
</tr>
<tr>
<td>2</td>
<td>0.40</td>
<td>0.65</td>
<td>0.035</td>
<td>0.084</td>
<td>0.197</td>
<td>0.064</td>
<td>0.360</td>
<td>0.477</td>
</tr>
<tr>
<td>3</td>
<td>0.32</td>
<td>0.55</td>
<td>0.035</td>
<td>0.084</td>
<td>0.197</td>
<td>0.064</td>
<td>0.360</td>
<td>0.477</td>
</tr>
<tr>
<td>4 except Marine</td>
<td>0.32</td>
<td>0.55</td>
<td>0.035</td>
<td>0.084</td>
<td>0.197</td>
<td>0.064</td>
<td>0.360</td>
<td>0.477</td>
</tr>
</tbody>
</table>

NR = Not Required. For SI: 1 foot = 304.8 mm.

a. All values are minimums. U-factors and SHGC are maximums. Where insulation is installed in a wall that is less than the label or design thickness of the insulation, the installed R-value of the insulation shall be not less than the R-value specified in the table.

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

c. Exception: In Climate Zones 1 through 3, skylights shall be permitted to be excluded from glazed fenestration SHGC requirements provided that the SHGC for such skylights does not exceed 0.30.

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

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

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

g. Alternatively, insulation sufficient to fill the framing cavity and providing not less than an R-value of 0.19.

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

i. Mass walls shall be in accordance with Section R402.2.5. The second R-value applies where more than half of the insulation is on the interior of the mass wall.
<table>
<thead>
<tr>
<th>Climate Zone</th>
<th>Annual Energy Cost Savings</th>
<th>Present Value Life Cycle Benefit</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>0.7%</td>
<td>$42</td>
</tr>
<tr>
<td>3</td>
<td>0.9%</td>
<td>$126</td>
</tr>
</tbody>
</table>

These proposed changes are also well within the range specified by the U.S. DOE's insulation guidelines for climate zones 2 and 3 of R30 to R60.


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

Requiring more insulation will increase the cost of construction, but the resulting energy and cost savings will recoup the initial costs and will continue to benefit consumers over the useful life of the home.
2018 International Energy Conservation Code

Revised as follows:

### Table R402.1.2

**Insulation and Fenestration Requirements by Component**

<table>
<thead>
<tr>
<th>Climate Zone</th>
<th>U-factor</th>
<th>Skylight U-factor</th>
<th>Glazed Fenestration SHGC</th>
<th>Ceiling R-value</th>
<th>Woodframe Wall R-value</th>
<th>Masonry Wall R-value</th>
<th>Floor R-value</th>
<th>Basement R-value</th>
<th>Slab R-value</th>
<th>Crawlspace R-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>NR</td>
<td>0.75</td>
<td>0.25</td>
<td>30</td>
<td>13</td>
<td>3.4</td>
<td>13</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>2</td>
<td>0.40</td>
<td>0.65</td>
<td>0.25</td>
<td>36</td>
<td>13</td>
<td>4.6</td>
<td>13</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>3</td>
<td>0.32</td>
<td>0.55</td>
<td>0.40</td>
<td>49</td>
<td>20 or 13+5p</td>
<td>5/13</td>
<td>19</td>
<td>10/13</td>
<td>10.2 ft</td>
<td>10/13</td>
</tr>
<tr>
<td>4 except Marine</td>
<td>0.30</td>
<td>0.55</td>
<td>NR</td>
<td>49</td>
<td>20 or 13+5p</td>
<td>13/17</td>
<td>30</td>
<td>15/19</td>
<td>10.2 ft</td>
<td>15/19</td>
</tr>
<tr>
<td>5 and Marine</td>
<td>0.30</td>
<td>0.55</td>
<td>NR</td>
<td>49</td>
<td>20 or 13+5p</td>
<td>15/20</td>
<td>30</td>
<td>15/19</td>
<td>10.4 ft</td>
<td>15/19</td>
</tr>
<tr>
<td>7 and 8</td>
<td>0.30</td>
<td>0.55</td>
<td>NR</td>
<td>49</td>
<td>20 or 13+5p</td>
<td>15/21</td>
<td>38</td>
<td>15/19</td>
<td>10.4 ft</td>
<td>15/19</td>
</tr>
</tbody>
</table>

**Notes:**
- NR = Not Required. For SI: 1 foot = 304.8 mm.
- U-values are minimums. U-factors and SHGC are maximums. Where insulation is installed in a cavity that is less than the label or design thickness of the insulation, the installed R-value of the insulation shall be not less than the R-value specified in the table.
- The fenestration U-factor column excludes skylights. The SHGC column applies to all glazed fenestration.

**Exception:** In Climate Zones 1 through 3, skylights shall be permitted to be excluded from glazed fenestration SHGC requirements provided that the SHGC for such skylights does not exceed 0.30.

- “10/13” means R-10 continuous insulation on the interior or exterior of the home or R-13 cavity insulation on the interior of the basement wall. “15/19” means R-15 continuous insulation on the interior or exterior of the home or R-19 cavity insulation at the interior of the basement wall. Alternatively, compliance with “15/19” shall be R-13 cavity insulation on the interior of the basement wall plus R-5 continuous insulation on the interior or exterior of the home.
- R-5 insulation shall be provided under the full slab area of a heated slab in addition to the required slab edge insulation R-value for slabs, as indicated in the table. The slab edge insulation for heated slabs shall not be required to extend below the slab.
- There are no SHGC requirements in the Marine Zone.
- Basement wall insulation is not required in warm-humid locations as defined by Figure R301.1 and Table R301.1.
- Alternately, insulation sufficient to fill the framing cavity and providing not less than an R-value of R-10.
- The first value is cavity insulation, the second value is continuous insulation. Therefore, as an example, “13+5” means R-13 cavity insulation plus R-5 continuous insulation.
Reason: The purpose of this code change proposal is to improve the efficiency of homes in the coldest climate zones by removing an exception that allows weaker floor insulation R-values with no corresponding improvements elsewhere in the building. The current footnote “g” to Table R402.1.2 is a loophole that permits builders to reduce floor insulation (which will lead to a less comfortable home and increased energy costs), simply because of design choices made by the builder. Indeed, this exception allows builders in climate zones 7 and 8 to install half the insulation required by code.

The proposal above does not prohibit a builder from continuing to build floors with any specific floor joist thickness. However, if adequate insulation cannot be installed in the floor cavity, the energy efficiency losses must be accounted for elsewhere in the thermal envelope through a trade-off.

Cost Impact: The code change proposal will increase the cost of construction. However, the proposal will only increase construction costs for homes that might have taken advantage of this exception in the prescriptive path because it will require the installation of insulation sufficient to meet the R-value requirement in Table R402.1.2. However, this change will not increase costs for homes built to all other compliance paths in the IECC, since the footnote exception already does not apply to those homes. We believe the elimination of this exception will provide homeowners with the superior comfort and energy and cost-savings they expect from a code-compliant home.

Proposal # 4015
2018 International Energy Conservation Code

Revise as follows:

### TABLE R402.1.2 (IRC N1102.1.2)

<table>
<thead>
<tr>
<th>CLIMATEZONE</th>
<th>FENESTRATION U-FACTOR</th>
<th>SKYLIGHT U-FACTOR</th>
<th>GLAZED FENESTRATION SHGC</th>
<th>CEILING VALUE</th>
<th>WOODFRAME 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</th>
<th>CRAWLSPACE WALL R-VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0.40</td>
<td>0.25</td>
<td>0.25</td>
<td>30</td>
<td>13</td>
<td>3.4</td>
<td>13</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>2</td>
<td>0.32</td>
<td>0.32</td>
<td>0.55</td>
<td>38</td>
<td>13</td>
<td>4.6</td>
<td>13</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>4 except Marine</td>
<td>0.32</td>
<td>0.32</td>
<td>0.55</td>
<td>49</td>
<td>20 or 13+0.5</td>
<td>8/13</td>
<td>19</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>5 and Marine 4</td>
<td>0.32</td>
<td>0.32</td>
<td>0.55</td>
<td>49</td>
<td>20 or 13+0.5</td>
<td>13/17</td>
<td>30</td>
<td>15/19</td>
<td>10/13</td>
<td>10/13</td>
</tr>
<tr>
<td>6</td>
<td>0.32</td>
<td>0.32</td>
<td>0.55</td>
<td>NR</td>
<td>20 or 13+0.5</td>
<td>15/19</td>
<td>10/4</td>
<td>15/19</td>
<td>10/13</td>
<td>10/13</td>
</tr>
<tr>
<td>7 and 8</td>
<td>0.32</td>
<td>0.32</td>
<td>0.55</td>
<td>NR</td>
<td>20 or 13+0.5</td>
<td>19/21</td>
<td>10/4</td>
<td>15/19</td>
<td>10/13</td>
<td>10/13</td>
</tr>
</tbody>
</table>

NR = Not Required. For SI: 1 foot = 304.8 mm.

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

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

c. "10/13" means R-10 continuous insulation on the interior or exterior of the home or R-13 cavity insulation on the interior of the basement wall. "15/19" means R-15 continuous insulation on the interior or exterior of the home or R-19 cavity insulation at the interior of the basement wall. Alternatively, compliance with "15/19" shall be R-13 cavity insulation on the interior of the basement wall plus R-5 continuous insulation on the interior or exterior of the home.

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

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

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

g. Alternatively, insulation sufficient to fill the framing cavity and providing not less than an R-value of R-19.

h. The first value is cavity insulation, the second value is continuous insulation. Therefore, as an example, "13+5" means R-13 cavity insulation plus R-5 continuous insulation.

i. Mass walls shall be in accordance with Section R402.2.5. The second R-value applies where more than half of the insulation is on the interior of the mass wall.

j. A maximum U-factor of 0.32 shall apply in Climate Zones 3 through 8 to vertical fenestration products installed in buildings located either:
1. Above 4000 feet in elevation above sea level, or
2. In windborne debris regions where protection of openings is required by Section R301.2.1.2 of the International Residential Code.

**TABLE R402.1.4 (IRC N1102.1.4)**

<table>
<thead>
<tr>
<th>CLIMATEZONE</th>
<th>FENESTRATION U-FACTOR</th>
<th>SKYLIGHT U-FACTOR</th>
<th>CEILING U-FACTOR</th>
<th>FRAMEWALL U-FACTOR</th>
<th>MASS WALL U-FACTOR&lt;sup&gt;b&lt;/sup&gt;</th>
<th>FLOOR U-FACTOR</th>
<th>BASEMENT WALL U-FACTOR</th>
<th>CRAWLSPACE WALL U-FACTOR</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0.50</td>
<td>0.75</td>
<td>0.035</td>
<td>0.084</td>
<td>0.197</td>
<td>0.064</td>
<td>0.360</td>
<td>0.477</td>
</tr>
<tr>
<td>2</td>
<td>0.40 0.35</td>
<td>0.65</td>
<td>0.030</td>
<td>0.084</td>
<td>0.165</td>
<td>0.064</td>
<td>0.360</td>
<td>0.477</td>
</tr>
<tr>
<td>3</td>
<td>0.32 0.30</td>
<td>0.55</td>
<td>0.030</td>
<td>0.060</td>
<td>0.098</td>
<td>0.047</td>
<td>0.091&lt;sup&gt;c&lt;/sup&gt;</td>
<td>0.136</td>
</tr>
<tr>
<td>4 except Marine</td>
<td>0.32 0.30</td>
<td>0.55</td>
<td>0.026</td>
<td>0.060</td>
<td>0.098</td>
<td>0.047</td>
<td>0.059</td>
<td>0.065</td>
</tr>
<tr>
<td>5 and Marine 4</td>
<td>0.30</td>
<td>0.55</td>
<td>0.026</td>
<td>0.060</td>
<td>0.082</td>
<td>0.033</td>
<td>0.050</td>
<td>0.055</td>
</tr>
<tr>
<td>6</td>
<td>0.30</td>
<td>0.55</td>
<td>0.026</td>
<td>0.045</td>
<td>0.060</td>
<td>0.033</td>
<td>0.050</td>
<td>0.055</td>
</tr>
<tr>
<td>7 and 8</td>
<td>0.30</td>
<td>0.55</td>
<td>0.026</td>
<td>0.045</td>
<td>0.057</td>
<td>0.028</td>
<td>0.050</td>
<td>0.055</td>
</tr>
</tbody>
</table>

a. Nonfenestration U-factors shall be obtained from measurement, calculation or an approved source.
b. Mass walls shall be in accordance with Section R402.2.5. Where more than half the insulation is on the interior, the mass wall U-factors shall not exceed 0.17 in Climate Zone 1, 0.14 in Climate Zone 2, 0.12 in Climate Zone 3, 0.087 in Climate Zone 4 except Marine, 0.065 in Climate Zone 5 and Marine 4, and 0.057 in Climate Zones 6 through 8.
c. In warm-humid locations as defined by Figure R301.1 and Table R301.1, the basement wall U-factor shall not exceed 0.360.

**Reason:** The purpose of this code change proposal is to improve occupant comfort and save energy by upgrading and strengthening fenestration.
U-factors in climate zones 2 – 4 (by lowering them consistent with modest step improvements in previous code cycles). Fenestration that meets these requirements is cost-effective and will return substantial life cycle savings to homeowners, is already widely available, and is routinely installed in new and existing residential buildings in these climate zones. This proposal also adds a footnote to establish an exception to prescriptive U-factors for fenestration installed at high altitudes (above 4000 feet in elevation) and in regions that require fenestration to be resistant to windborne debris in climate zones 3 - 8. A similar footnote exception was proposed in the last code development cycle and was widely supported by building code officials in these specific regions. Overall, this proposal will improve energy efficiency across much of the nation while allowing reasonable options for fenestration in high-altitude and wind-borne debris regions.

Energy Savings and Cost-Effectiveness - Our analysis, based on the DOE cost-effectiveness methodology, shows the improvements in U-factor to be cost-effective to the consumer with a substantial lifecycle benefit:

<table>
<thead>
<tr>
<th>Climate Zone</th>
<th>Annual Energy Cost Savings</th>
<th>Present Value Life Cycle Benefit</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>0.9%</td>
<td>$273</td>
</tr>
<tr>
<td>3</td>
<td>1.0%</td>
<td>$312</td>
</tr>
<tr>
<td>4</td>
<td>1.1%</td>
<td>$353</td>
</tr>
</tbody>
</table>

Although we believe that the upgrade in the standards will result in no cost increase in most cases, because the new specification is consistent with the standard product already used in the marketplace (as discussed below), for purposes of the life cycle cost analysis above, we used a marginal upgrade cost to be conservative. Even with this approach, the life cycle benefit is robust.

Availability of Compliant Products and Adoption – A 0.30 U-factor requirement is a natural technology level/breakpoint representing a reasonably efficient, double pane, low-e with argon wood or vinyl window. As a result, a number of national and state programs have promoted fenestration U-factors in the range of 0.30 for several years, making these products widely available and already being installed throughout most of the country:

- For example, the American Recovery and Reinvestment Act of 2009 (ARRA) provided a federal income tax credit for fenestration with a U-factor of 0.30 or lower.
- Energy Star has required 0.30 U-factors (or less) for fenestration installed in all but the southernmost climate zones since January 1, 2015. See https://www.energystar.gov/sites/default/files/ES_Final_V6_Residential_WDS_V6_Spec.pdf
- These findings were reinforced through the U.S. DOE Residential Field Studies, which found that even in states in climate zones 2 – 4, with weaker code U-factor requirements, builders were routinely installing fenestration with U-factors around 0.30. See https://www.energycodes.gov/sites/default/files/documents/Field_Study_120715_Final.pdf.

Because of these national trends toward 0.30 U-factor or better fenestration, compliance will not be an issue and in most cases will not even result in an increase in construction costs.

Proposed Exception for Special Circumstances - We believe that the proposed exception is warranted due to the special measures that are taken by glass and/or fenestration manufacturers to address higher altitudes and windborne debris due to high winds.

For example, high altitude products may incorporate breather or capillary tubes in the insulating glass unit to allow pressure equalization for products that will be transported to higher elevations for installation. The pressure equalization can help avoid IG unit failures. However, the capillary tubes eliminate the ability to use certain gas fills commonly used to achieve higher levels of thermal performance. The limited exception proposed above recognizes that circumstance and provides some flexibility for builders in these regions.

Likewise, fenestration designed to withstand windborne debris usually requires special glass which (because of its increased thickness) reduces the gap width in the insulating glass unit. This will affect the thermal performance of the window. To provide some additional flexibility in zones where such fenestration is required, this proposal permits a fenestration U-factor of 0.32 for climate zones 3-8.

In sum, we believe this proposal will implement meaningful energy and cost savings and improved occupant comfort through improved fenestration U-factors that are already available and are routinely being installed by homebuilders.

Cost Impact: The code change proposal will increase the cost of construction. It is possible that requiring more efficient fenestration may, in some cases, increase the cost of construction (and, as a result, we used an upgrade cost in our life cycle cost/benefit analysis), but in any event, the resulting energy and cost savings will overwhelmingly recoup the initial costs and will continue to benefit consumers over the useful life of the home. Moreover, it should also be noted that we would expect that the U-factor reduction will not increase costs in most cases, since the standard market products, with very high market penetration, already typically hit the proposed improved U-factor levels. We also note that for builders in high-altitude or wind-borne debris regions, the new footnote will provide additional flexibility and will likely serve to reduce costs.
Proponent: William Fay, Energy-Efficient Codes Coalition, representing Energy-Efficient Codes Coalition (bfay@ase.org); Daniel Bresette, Alliance to Save Energy, representing Alliance to Save Energy (dbresette@ase.org); Maureen Guttman, BCAP-IBTS, representing BCAP-IBTS (mguttman@bcapcodes.org); Harry Misuriello, American Council for an Energy-Efficient Economy, representing American Council for an Energy-Efficient Economy (misuriello@verizon.net)

2018 International Energy Conservation Code
Revise as follows:

TABLE R402.1.2 (IRC N1102.1.2)
INSULATION AND FENESTRATION REQUIREMENTS BY COMPONENT

<table>
<thead>
<tr>
<th>CLIMATEZONE</th>
<th>FENESTRATION U-FACTOR</th>
<th>SKYLIGHT U-FACTOR</th>
<th>GLAZED FENESTRATION SHGC</th>
<th>CEILING R-VALUE</th>
<th>WOODFRAME 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</th>
<th>CRAWLSPACE WALL R-VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0.50</td>
<td>0.75</td>
<td>0.25</td>
<td>30</td>
<td>13</td>
<td>0.197</td>
<td>0.064</td>
<td>0.360</td>
<td>0.477</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>0.40</td>
<td>0.65</td>
<td>0.25</td>
<td>38</td>
<td>13</td>
<td>0.197</td>
<td>0.064</td>
<td>0.360</td>
<td>0.477</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>0.32</td>
<td>0.55</td>
<td>0.25</td>
<td>28</td>
<td>20 or 13+5</td>
<td>0.024</td>
<td>0.060</td>
<td>0.098</td>
<td>0.047</td>
<td>0.091c</td>
</tr>
<tr>
<td>4 except Marine</td>
<td>0.32</td>
<td>0.55</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

NR = Not Required. For SI: 1 foot = 304.8 mm.

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

Exception: In Climate Zones 1 through 3, skylights shall be permitted to be excluded from glazed fenestration SHGC requirements provided that the SHGC for such skylights does not exceed 0.30.

c. "10/13" means R-10 continuous insulation on the interior or exterior of the home or R-13 cavity insulation on the interior of the basement wall. "15/19" means R-15 continuous insulation on the interior or exterior of the home or R-19 cavity insulation at the interior of the basement wall. Alternatively, compliance with "15/19" shall be R-13 cavity insulation on the interior of the basement wall plus R-5 continuous insulation on the interior or exterior of the home.

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

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

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

g. Alternatively, insulation sufficient to fill the framing cavity and providing not less than an R-value of R-19.

h. The first value is cavity insulation, the second value is continuous insulation. Therefore, as an example, "13+5" means R-13 cavity insulation plus R-5 continuous insulation.

i. Mass walls shall be in accordance with Section R402.2.5. The second R-value applies where more than half of the insulation is on the interior of the mass wall.

TABLE R402.1.4 (IRC N1102.1.4)
EQUIVALENT U-FACTORS

<table>
<thead>
<tr>
<th>CLIMATEZONE</th>
<th>FENESTRATION U-FACTOR</th>
<th>SKYLIGHT U-FACTOR</th>
<th>CEILING U-FACTOR</th>
<th>FRAMEWORK WALL U-FACTOR</th>
<th>MASS WALL U-FACTOR</th>
<th>FLOOR U-FACTOR</th>
<th>BASEMENT WALL U-FACTOR</th>
<th>CRAWLSPACE WALL U-FACTOR</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0.50</td>
<td>0.75</td>
<td>0.035</td>
<td>0.084</td>
<td>0.197</td>
<td>0.064</td>
<td>0.360</td>
<td>0.477</td>
</tr>
<tr>
<td>2</td>
<td>0.40</td>
<td>0.65</td>
<td>0.030</td>
<td>0.084</td>
<td>0.197</td>
<td>0.064</td>
<td>0.360</td>
<td>0.477</td>
</tr>
<tr>
<td>3</td>
<td>0.32</td>
<td>0.55</td>
<td>0.030</td>
<td>0.060</td>
<td>0.098</td>
<td>0.047</td>
<td>0.091c</td>
<td>0.136</td>
</tr>
<tr>
<td>4 except Marine</td>
<td>0.32</td>
<td>0.55</td>
<td>0.024</td>
<td>0.060</td>
<td>0.098</td>
<td>0.047</td>
<td>0.059</td>
<td>0.065</td>
</tr>
</tbody>
</table>
a. Nonfenestration $U$-factors shall be obtained from measurement, calculation or an approved source.

b. Mass walls shall be in accordance with Section R402.2.5. Where more than half the insulation is on the interior, the mass wall $U$-factors shall not exceed 0.17 in Climate Zone 1, 0.14 in Climate Zone 2, 0.12 in Climate Zone 3, 0.087 in Climate Zone 4 except Marine, 0.065 in Climate Zone 5 and Marine 4, and 0.057 in Climate Zones 6 through 8.

c. In warm-humid locations as defined by Figure R301.1 and Table R301.1, the basement wall $U$-factor shall not exceed 0.360.

R402.2.1 (IRC N1102.2.1) Ceilings with attic spaces. Where Section R402.1.2 requires R-38 insulation in the ceiling, installing R-30 over 100 percent of the ceiling area requiring insulation shall satisfy the requirement for R-38 wherever the full height of uncompressed R-30 insulation extends over the wall top plate at the eaves. Where Section R402.1.2 requires R-49 insulation in the ceiling, installing R-38 over 100 percent of the ceiling area requiring insulation shall satisfy the requirement for R-49 insulation wherever the full height of uncompressed R-38 insulation extends over the wall top plate at the eaves. Where Section R402.1.2 requires R-60 insulation in the ceiling, installing R-49 over 100 percent of the ceiling area requiring insulation shall satisfy the requirement for R-60 insulation wherever the full height of uncompressed R-49 insulation extends over the wall top plate at the eaves. This reduction shall not apply to the $U$-factor alternative approach in Section R402.1.4 and the Total UA alternative in Section R402.1.5.

Reason: The purpose of this code change proposal is to improve comfort and save energy for homeowners in climate zones 4 - 8 by upgrading and increasing ceiling insulation requirements from R-49 to R-60. Small improvements to the thermal envelope can have a significant beneficial impact, particularly in light of a home's long expected useful life. Insulation in particular may not be changed for many decades and may last for the full useful life of the building, providing consistent comfort and energy saving benefits over that period. Making long-lived, life cycle cost beneficial improvements is consistent with the intent of the IECC (R101.3), which is to “regulate the design and construction of buildings for the effective use and conservation of energy over the useful life of each building.” Using DOE’s cost-effectiveness methodology, we found these R-value improvements would provide substantial life cycle cost benefits:

<table>
<thead>
<tr>
<th>Climate Zone</th>
<th>Annual Energy Cost Savings</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>0.6%</td>
</tr>
<tr>
<td>5</td>
<td>0.7%</td>
</tr>
<tr>
<td>6</td>
<td>0.6%</td>
</tr>
<tr>
<td>7</td>
<td>0.5%</td>
</tr>
<tr>
<td>8</td>
<td>0.4%</td>
</tr>
</tbody>
</table>

These proposed changes are also within the range specified by the U.S. DOE's insulation guidelines for these climate zones. https://www.energy.gov/energysaver/weatherize/insulation A home with adequate insulation will maintain more consistent interior temperatures during both heating and cooling seasons and will be more resilient and livable in the event of extreme weather events and power outages.


Cost Impact: The code change proposal will increase the cost of construction. Requiring more insulation will increase the cost of construction, but the resulting energy and cost savings will recoup the initial costs and will continue to benefit consumers over the useful life of the home.
RE37-19

IECC: TABLE R402.1.2 (IRC N1102.1.2)

**Proponent:** William Fay, Energy-Efficient Codes Coalition, representing Energy-Efficient Codes Coalition (bfay@ase.org); Daniel Bresette, Alliance to Save Energy, representing Alliance to Save Energy (dbresette@ase.org); Maureen Gutman, BCAP-IBTS, representing BCAP-IBTS (mguttman@bcapcodes.org); Harry Misuriello, American Council for an Energy-Efficient Economy, representing American Council for an Energy-Efficient Economy (misuriello@verizon.net)

2018 International Energy Conservation Code

Revis as follows:

**Reason:** The purpose of this code change proposal is to improve occupant comfort, reduce peak demand and HVAC sizing, and reduce costs for homeowners by establishing a moderate SHGC requirement for fenestration in climate zone 5. While we believe that the vast majority of fenestration installed in climate zone 5 already meets or exceeds this level of efficiency, and the performance path already assumes this same level (a 0.40 SHGC) for climate zone 5, this proposal will encourage the use of fenestration with proven efficiency and comfort benefits.

**Comfort** – A window that combines both a low U-factor (which is already required for climate zone 5) with a low SHGC will help reduce the volatility of interior temperature swings and better maintain reasonable occupant comfort. According to the Efficient Windows Collaborative, based on an analysis completed by Lawrence Berkeley National Laboratory, windows with lower SHGCs reduce the amount of solar radiation passing through the glass, which will reduce the likelihood of discomfort of occupants. See https://www.efficientwindows.org/comfort.php. An uncomfortable occupant due to excessive solar gain through windows is more likely to adjust the thermostat to a cooler temperature over the course of the day in response, thereby increasing peak demand and energy use.

Although energy modeling software does not typically capture the likelihood of occupant response to discomfort, anyone who has lived or worked in
a building with excessive solar gain through fenestration, knows that this can lead occupants to adjust the thermostat. The energy impact of adjusting the thermostat is substantial. The following table shows the increased energy use that results from adjusting the thermostat down a single degree in a code-compliant house in each climate zone:

<table>
<thead>
<tr>
<th>Measure</th>
<th>Weighted</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
</tr>
</thead>
<tbody>
<tr>
<td>-1 Degree Cooling</td>
<td></td>
<td>3.0%</td>
<td>7.8%</td>
<td>5.3%</td>
<td>3.9%</td>
<td>2.6%</td>
<td>1.8%</td>
<td>1.4%</td>
<td>0.7%</td>
</tr>
</tbody>
</table>

Obviously, if an uncomfortable occupant adjusts the thermostat 2 or 3 degrees, the impact will be far higher.

Peak Demand and HVAC Sizing Savings – Low-SHGC fenestration helps reduce both the home and utility peak electric demand, providing a range of benefits for homeowners and communities. Low-SHGC fenestration helps reduce the need for air conditioning during peak hours when electricity is more scarce and more expensive. Reduced cooling needs can allow for the installation of smaller cooling equipment, benefitting the homeowner by lowering costs at construction and every time the air conditioning unit is replaced. Reduced peak electric demand for each home will also help curb the overall increases in utility peak electric demand, reducing costs and negative environmental impacts associated with installing and operating peak electric generation. See U.S. Department of Energy, Measure Guideline: Energy Efficient Window Performance and Selection, at 49, available at https://www.nrel.gov/docs/fy13osti/55444.pdf.

Market Availability - Given the U-factor requirement in climate zone 5 (currently 0.30), the overwhelming majority of products being installed in this climate are already well under a 0.40 SHGC. Indeed, according to a 2015 U.S. DOE field study of homes in Pennsylvania (which had no SHGC requirement), 100% of the observed fenestration SHGC was below 0.40. In fact, the highest SHGC observed was 0.32. See https://www.energycodes.gov/compliance/energy-code-field-studies. While this study was limited to one state and a limited sample, we have seen no evidence that the circumstances are different in other climate zone 5 states. Given the ubiquity of low-SHGC fenestration in climate zone 5, we believe that this proposal will not significantly change, but merely recognize practices already implemented by homebuilders.


Cost Impact: The code change proposal will not increase or decrease the cost of construction. We believe that the vast majority of windows being installed in climate zone 5 already meet this SHGC level, and for any that do not, there are many standard products in the market that will meet it for no additional cost (the vast majority of windows that meet the U-factors specified for climate zone 5 already have a lower SHGC than 0.40; the lower SHGC typically comes with the lower U-factor). A lower SHGC may also provide the opportunity to reduce the size of the HVAC system, thereby reducing construction cost. As a result, any increased or decreased cost impact is dependent on specific circumstances and is uncertain.
Proponent: David Collins, representing The American Institute of Architects (dcollins@preview-group.com); Jay Crandell, representing Foam Sheathing Committee of the American Chemistry Council (jcrandell@aresconsulting.biz); Maureen Guttman, representing BCAP-IBTS (mguttph@aol.com)

2018 International Energy Conservation Code

Revise as follows:

R402.1.2 (IRC N1102.1.2) Insulation and fenestration criteria. The building thermal envelope shall meet the requirements of Table R402.1.2, based on the climate zone specified in Chapter 3. Assemblies shall have a U-factor equal to or less than that specified in Table R402.1.2. Fenestration shall have a U-factor and glazed fenestration SHGC equal to or less than specified in Table R402.1.2.

Add new text as follows:

R402.1.3 (IRC N1102.1.3) R-value alternative. Assemblies with R-value of insulation materials equal to or greater than that specified in Table R402.1.3 shall be an alternative to the U-factor in Table R402.1.2.

Revise as follows:

<table>
<thead>
<tr>
<th>CLIMATEZONE</th>
<th>FENESTRATION/U-SKYLIGHTU-FACTOR</th>
<th>GLAZED FENESTRATION SHGC**</th>
<th>CEILINGU-FRAMEWALLU-FACTOR</th>
<th>MASS WALLU-FACTOR</th>
<th>FLOORU-BASEMENTWALLU-FAC</th>
<th>CRAWLSPACE WALLU-FAC</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0.50</td>
<td>0.25</td>
<td>0.035</td>
<td>0.084</td>
<td>0.197</td>
<td>0.064</td>
</tr>
<tr>
<td>2</td>
<td>0.40</td>
<td>0.25</td>
<td>0.030</td>
<td>0.084</td>
<td>0.165</td>
<td>0.064</td>
</tr>
<tr>
<td>3</td>
<td>0.32</td>
<td>0.25</td>
<td>0.030</td>
<td>0.060</td>
<td>0.094</td>
<td>0.047</td>
</tr>
<tr>
<td>4 except Marine</td>
<td>0.32</td>
<td>0.40</td>
<td>0.028</td>
<td>0.060</td>
<td>0.098</td>
<td>0.047</td>
</tr>
<tr>
<td>5 and Marine 4</td>
<td>0.30</td>
<td>0.55</td>
<td>NR</td>
<td>0.026</td>
<td>0.060</td>
<td>0.083</td>
</tr>
<tr>
<td>6</td>
<td>0.30</td>
<td>0.55</td>
<td>NR</td>
<td>0.026</td>
<td>0.045</td>
<td>0.060</td>
</tr>
<tr>
<td>7 and 8</td>
<td>0.30</td>
<td>0.55</td>
<td>NR</td>
<td>0.026</td>
<td>0.045</td>
<td>0.057</td>
</tr>
</tbody>
</table>

a. Nonfenestration U-factors shall be obtained from measurement, calculation or an approved source.
b. Mass walls shall be in accordance with Section R402.2.5. Where more than half the insulation is on the interior, the mass wall U-factors shall not exceed 0.17 in Climate Zone 1, 0.14 in Climate Zone 2, 0.12 in Climate Zone 3, 0.087 in Climate Zone 4 except Marine, 0.065 in Climate Zone 5 and Marine 4, and 0.057 in Climate Zones 6 through 8.
c. In warm-humid locations as defined by Figure R301.1 and Table R301.1, the basement wall U-factor shall not exceed 0.360.
d. The SHGC column applies to all glazed fenestration.

Exception: In Climate Zones 1 through 3, skylights shall be permitted to be excluded from glazed fenestration SHGC requirements provided that the SHGC for such skylights does not exceed 0.30.

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

Portions of table not shown remain unchanged.
R402.1.3 (IRC N1102.1.3) R402.1.4 (IRC N1102.1.4) R-value computation. Insulation material used in layers, such as framing cavity insulation or continuous insulation, shall be summed to compute the corresponding component R-value. The manufacturer’s settled R-value shall be used for blown-in insulation. Computed R-values shall not include an R-value for other building materials or air films. Where insulated siding is used for the purpose of complying with the continuous insulation requirements of Table R402.1.2, the manufacturer’s labeled R-value for the insulated siding shall be reduced by R-0.6.

R402.1.4 (IRC N1102.1.4) U-factor alternative. An assembly with a U-factor equal to or less than that specified in Table R402.1.4 shall be an alternative to the R-value in Table R402.1.2.

R402.1.5 (IRC N1102.1.5) Total UA alternative. Where the total building thermal envelope UA, the sum of U-factor times assembly area, is less than or equal to the total UA resulting from multiplying the U-factors in Table R402.1.4 by the same assembly area as in the proposed building, the building shall be considered to be in compliance with Table R402.1.2. The UA calculation shall be performed using a method consistent with the ASHRAE Handbook of Fundamentals and shall include the thermal bridging effects of framing materials. In addition to UA compliance, the SHGC requirements shall be met.

Reason: This proposal does not change the stringency of the R-value and U-factor requirements. This proposal organizes the envelope thermal requirements such that the basis of performance (and any other means of compliance) is founded on U-factors which completely define an assembly’s performance. The R-value approach is kept to provide pre-determined solutions (easy to look up) and it is based on the U-factor requirements as it should be (and the same would apply to any other equivalent R-value solution that one might propose as an alternative for compliance). This approach does not change the prescriptive R-value approach or the ability to use it for simple solutions. Instead, it better ensures that the R-values used are a derivative of the intended performance levels that are non-material specific and represented by the assembly U-factors. Also, fenestration and SHGC requirements are included in the U-factor table because they are currently omitted. The SHGC values (and footnotes) are consistent with those in the current R-value table.

Cost Impact: The code change proposal will not increase or decrease the cost of construction. This proposal does not change the stringency of R-value and U-factor requirements, but it will ensure that alternate R-value solutions are appropriately based on the U-factor requirements, including those that are predetermined in the R-value table which is kept to maintain a simple means of compliance.
2018 International Energy Conservation Code

Revise as follows:

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**TABLE R402.1.2 (IRC N1102.1.2)**

<table>
<thead>
<tr>
<th>CLIMATEZONE</th>
<th>FENESTRATION FACTOR</th>
<th>SKYLIGHT FACTOR</th>
<th>GLAZED FENESTRATION SHGC $^a$</th>
<th>CEILING VALUE</th>
<th>WOODFRAME WALL R-VALUE</th>
<th>MASS WALL R-VALUE $^b$</th>
<th>FLOOR R-VALUE</th>
<th>BASEMENT WALL R-VALUE</th>
<th>SLAB R-VALUE</th>
<th>CRAWLSPACE WALL R-VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>0.40</td>
<td>0.65</td>
<td>0.25</td>
<td>38</td>
<td>10</td>
<td>8/13</td>
<td>19</td>
<td>10/13</td>
<td>10.2 ft</td>
<td>15/19</td>
</tr>
<tr>
<td>3</td>
<td>0.32</td>
<td>0.55</td>
<td>0.25</td>
<td>38</td>
<td>20 or 13+3$^b$</td>
<td>8/13</td>
<td>19</td>
<td>10/13</td>
<td>10.2 ft</td>
<td>15/19</td>
</tr>
<tr>
<td>4 except Marine</td>
<td>0.32</td>
<td>0.55</td>
<td>0.40</td>
<td>49</td>
<td>20 or 13+3$^b$</td>
<td>8/13</td>
<td>19</td>
<td>10/13</td>
<td>10.2 ft</td>
<td>15/19</td>
</tr>
<tr>
<td>5 and Marine 4</td>
<td>0.30</td>
<td>0.55</td>
<td>NR</td>
<td>49</td>
<td>20 or 13+3$^b$</td>
<td>13/17</td>
<td>30$^b$</td>
<td>15/19</td>
<td>10.4 ft</td>
<td>15/19</td>
</tr>
</tbody>
</table>

Option 1

| 6           | 0.30                 | 0.55            | NR                         | 49            | 20 or 13+3$^b$         | 13/17                  | 30$^b$       | 15/19                  | 10.4 ft      | 15/19                   |

Option 2

| 7 and 8     | 0.28                 | 0.55            | NR                         | 50            | 23$^d$                 | 15/20                  | 30$^d$       | 15/19                  | 10.4 ft      | 15/19                   |

---

**Notes:**

NR = Not Required. For SI: 1 foot = 304.8 mm.

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

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

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

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

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

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

g. Alternatively, insulation sufficient to fill the framing cavity and providing not less than an R-value of R-19.

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

i. Mass walls shall be in accordance with Section R402.2.5. The second R-value applies where more than half of the insulation is on the interior of the mass wall.

j. Permitted only where the fenestration U-factor is 0.28 and the ceiling R-value is 60.

R402.2.1 (IRC N1102.2.1) Ceilings with attic spaces. Where Section R402.1.2 requires R-38 insulation in the ceiling, installing R-30 over 100 percent of the ceiling area requiring insulation shall satisfy the requirement for R-38 wherever the full height of uncompressed R-30 insulation extends over the wall top plate at the eaves. Where Section R402.1.2 requires R-49 insulation in the ceiling, installing R-38 over 100 percent of the ceiling area requiring insulation shall satisfy the requirement for R-49 insulation wherever the full height of uncompressed R-38 insulation extends over the wall top plate at the eaves. Where Section R402.1.2 requires R-60 insulation in the ceiling, installing R-49 over 100 percent of the ceiling area requiring insulation shall satisfy the requirement for R-60 insulation wherever the full height of uncompressed R-49 insulation extends over the top plate at the eaves. This reduction shall not apply to the U-factor alternative approach in Section R402.1.4 and the Total UA alternative in Section R402.1.5.

R402.2.2 (IRC N1102.2.2) Ceilings without attic spaces. Where Section R402.1.2 requires R-38 insulation in the ceiling and the design of the roof/ceiling assembly does not allow sufficient space for the required insulation, the minimum required insulation R-value for such roof/ceiling assemblies shall be R-30. Where Section R402.1.2 requires R-49 in the ceiling and the design of the roof/ceiling assembly does not allow sufficient space for the required insulation, the required insulation R-value for such roof/ceiling assemblies shall be R-38. Insulation shall extend over the top of the wall plate to the outer edge of the wall plate and shall not be compressed. This reduction of insulation from the requirements of Section R402.1.2 shall be limited to 500 square feet (46 m²) or 20 percent of the total insulated ceiling area, whichever is less. This reduction shall not apply to the U-factor alternative approach in Section R402.1.4 and the Total UA alternative in Section R402.1.5.

Reason: This proposal will save energy by providing a critically needed prescriptive cavity-only wall insulation option for Climate Zones 6-8 for the many builders and building officials that rely on the prescriptive table.

This new option provides equivalent energy performance by combining a minimum R23 wood frame wall R-value with better performing windows (U=0.28) and increased ceiling insulation (R60), such that equivalent energy performance is achieved.

The proposed R23 wall cavity insulation level is compatible with 2x6 framing using a variety of cavity insulation types, including several types of batt insulation products and blown-in insulation systems.
Verifying compliance in the field is easily done by checking the fenestration labels and insulation certificates and markers required by Sec. R303.

Note that this proposal does not modify the two existing continuous insulation assemblies already listed in Table R402.1.2, nor does it affect the U-factors in Table R402.1.4.

The proposed formatting of Table R402.1.2 in this proposal is identical to that of RE28-16 PC1 which was passed overwhelmingly by the assembly at the public comment hearings in Kansas City in 2016 before failing to achieve the supermajority by a single vote in online voting.


The energy efficiency of the proposed change was shown to provide better performance than the 2018 IECC using both an energy simulation analysis and a Total UA, REScheck analysis. Both analyses demonstrated better performance than the 2018 IECC. Both analyses used the U.S. Department of Energy Single Family Prototype for Determining the Cost Effectiveness of the 2018 IECC for house characteristics and square footage, in addition the simulated performance analysis uses U-factors and modeling guidelines in Sections R405.5.2(1) and R405.5.2(2) of the 2018 IECC for modeling the base or reference home.

1. Table R402.1.2 - Simulated Energy Performance Analysis:

<table>
<thead>
<tr>
<th>Option</th>
<th>Description</th>
<th>MMBTU/YR</th>
<th>Energy Cost YR</th>
<th>% Better</th>
</tr>
</thead>
<tbody>
<tr>
<td>Base</td>
<td>Base 2018 IECC</td>
<td>87.4</td>
<td>$1309.00</td>
<td>0.0%</td>
</tr>
<tr>
<td>Option 2</td>
<td>R-23 wood frame wall, U-0.28 vertical fenestration, R-60 attic</td>
<td>85.9</td>
<td>$1292.00</td>
<td>0.3%</td>
</tr>
</tbody>
</table>

1. Whole Home MMBTU/YR
2. Whole Home Energy Cost/YR
3. Square footages and attributes taken from the US DOE Single Family Prototype for Determining the Cost Effectiveness of the 2018 IECC and modeling guidelines in R405.5.2(1) and R405.5.2(2) of the 2018 IECC.

2. Table R402.1.2 - Total Building UA Analysis (REScheck):

<table>
<thead>
<tr>
<th>Option</th>
<th>Description</th>
<th>Overall U-Factor</th>
<th>% Better</th>
</tr>
</thead>
<tbody>
<tr>
<td>Base</td>
<td>Base 2018 IECC</td>
<td>313</td>
<td>0.0%</td>
</tr>
<tr>
<td>Option 2</td>
<td>R-23 wood frame wall, U-0.28 vertical fenestration, R-60 attic</td>
<td>309</td>
<td>1.3%</td>
</tr>
</tbody>
</table>

1. Square footages and attributes taken from the US DOE Single Family Prototype for Determining the Cost Effectiveness of the 2018 IECC.
2. Component U-factors calculated in accordance with the 2015 ASHRAE Handbook of Fundamentals.

Cost Impact: The code change proposal will not increase or decrease the cost of construction. This proposal offers an optional path for prescriptive envelope compliance. Because it is optional it cannot raise the cost of construction; a builder will choose whatever option they believe provides the greatest benefit for the cost.
2018 International Energy Conservation Code

Revise as follows:

### TABLE R402.1.2 (IRC N1102.1.2)

**INSULATION AND FENESTRATION REQUIREMENTS BY COMPONENT**

<table>
<thead>
<tr>
<th>CLIMATEZONE</th>
<th>FENESTRATIONU-FACTOR</th>
<th>SKYLIGHTU-FACTOR</th>
<th>GLAZEDFENESTRATIONSHGC&lt;sup&gt;a&lt;/sup&gt;</th>
<th>CEILINGR-VALUE</th>
<th>WOODFRAMEWALL-R-VALUE</th>
<th>MASSWALL-R-VALUE&lt;sup&gt;b&lt;/sup&gt;</th>
<th>FLOORR-VALUE</th>
<th>BASEMENTWALL-R-VALUE</th>
<th>SLAB&lt;sup&gt;r&lt;/sup&gt;-VALUE</th>
<th>CRAWLSPACEWALL-R-VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>NR</td>
<td>0.75</td>
<td>0.25</td>
<td>20</td>
<td>13</td>
<td>3/4</td>
<td>13</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>2</td>
<td>0.40</td>
<td>0.55</td>
<td>0.25</td>
<td>35</td>
<td>29</td>
<td>13/8</td>
<td>13</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>3</td>
<td>0.32</td>
<td>0.55</td>
<td>0.25</td>
<td>37</td>
<td>20(13+5)</td>
<td>8/13</td>
<td>19</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>4 exceptMarine</td>
<td>0.52</td>
<td>0.55</td>
<td>0.40</td>
<td>49</td>
<td>13</td>
<td>3/4</td>
<td>13</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>5 andMarine</td>
<td>0.30</td>
<td>0.55</td>
<td>NR</td>
<td>49</td>
<td>13</td>
<td>3/4</td>
<td>13</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>6</td>
<td>0.30</td>
<td>0.55</td>
<td>NR</td>
<td>49</td>
<td>13</td>
<td>3/4</td>
<td>13</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>7 and 8</td>
<td>0.30</td>
<td>0.55</td>
<td>NR</td>
<td>49</td>
<td>13</td>
<td>3/4</td>
<td>13</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

NR = Not Required. For SI: 1 foot = 304.8 mm.

- R-values are minimums. U-factors and SHGC are maximums. Where insulation is installed in a cavity that is less than the label or design thickness of the insulation, the installed R-value of the insulation shall be not less than the R-value specified in the table.
- The fenestration U-factor column excludes skylights. The SHGC column applies to all glazed fenestration.

**Exception:** In Climate Zones 1 through 3, skylights shall be permitted to be excluded from glazed fenestration SHGC requirements provided that the SHGC for such skylights does not exceed 0.30.

- "10/13" means R-10 continuous insulation on the interior or exterior of the home or R-13 cavity insulation on the interior of the basement wall. "15/19" means R-15 continuous insulation on the interior or exterior of the home or R-19 cavity insulation at the interior of the basement wall. Alternatively, compliance with "15/19" shall be R-13 cavity insulation on the interior of the basement wall plus R-5 continuous insulation on the interior or exterior of the home.
- R-5 insulation shall be provided under the full slab area of a heated slab in addition to the required slab edge insulation R-value for slabs, as indicated in the table. The slab edge insulation for heated slabs shall not be required to extend below the slab.
- There are no SHGC requirements in the Marine Zone.
- Basement wall insulation is not required in warm-humid locations as defined by Figure R301.1 and Table R301.1.
- Alternatively, insulation sufficient to fill the framing cavity and providing not less than an R-value of R-19.
- The first value is cavity insulation, the second value is continuous insulation. Therefore, as an example, "13+5" means R-13 cavity insulation plus R-5 continuous insulation.
i. Mass walls shall be in accordance with Section R402.2.5. The second R-value applies where more than half of the insulation is on the interior of the mass wall.

j. R-18 insulation shall be permitted in place of the R-20 requirement provided that the wall framing factor is 20% or less of exterior walls having 24 inch on center nominal vertical stud spacing.

**Reason:** This proposal is an energy neutral change based on calculations from ASHRAE. Insulation that is R-19 that is compressed in a 2 x 6 wall with stud spacing at 24 o.c. performs like R-18. The ASHRAE Handbook of Fundamentals and ASHRAE Transaction 1995 Volume 101, Part 2 assumes that wood framed walls have a framing factor of 25%. Meaning 25 percent of the wall area consists of structural framing members and the remainder of the wall is a cavity suitable for installing insulation. When calculating the U-factor for a wall assembly, a high framing factor increases the overall assembly U-Factor. Reducing the framing factor will also provide an increase in the thermal performance of the wall.

This proposal provides an option for a thermally equivalent tradeoff for 2x6 wall assemblies which have reduced framing factors and insulation performing like a R-18 insulator.

Below are the calculations showing equal U-Factors for both assemblies (0.060).
Cost Impact: The code change proposal will not increase or decrease the cost of construction. This proposal will offer an optional way for compliance, by allowing a framing and insulation alternative to what is currently in the code without reducing the overall efficiency.

2018 International Energy Conservation Code

Revise as follows:

TABLE R402.1.2 (IRC N1102.1.2)
INSULATION AND FENESTRATION REQUIREMENTS BY COMPONENT:

<table>
<thead>
<tr>
<th>CLIMATEZONE</th>
<th>FENESTRATIONU-FACTOR(s)</th>
<th>SKYLIGHTU-FACTOR</th>
<th>GLAZEDFENESTRATION</th>
<th>CEILING-R-VALUE</th>
<th>WOODFRAME WALL-R-VALUE</th>
<th>MASSWALL-R-VALUE</th>
<th>FLOOR-R-VALUE</th>
<th>BASEMENTWALL-R-VALUE</th>
<th>SLAB&amp;R-DEPTH</th>
<th>CRUELSPACEWALL-R-VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>NR</td>
<td>0.75</td>
<td>0.25</td>
<td>30</td>
<td>13</td>
<td>3/4</td>
<td>13</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>2</td>
<td>0.40</td>
<td>0.55</td>
<td>0.25</td>
<td>38</td>
<td>13</td>
<td>13</td>
<td>4/6</td>
<td>13</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>3</td>
<td>0.32</td>
<td>0.55</td>
<td>0.25</td>
<td>38</td>
<td>20 or 13+3</td>
<td>5/13</td>
<td>0</td>
<td>0</td>
<td>5/13</td>
<td>0</td>
</tr>
<tr>
<td>4 exceptMarine</td>
<td>0.32</td>
<td>0.55</td>
<td>0.40</td>
<td>49</td>
<td>20 or 13+3</td>
<td>5/13</td>
<td>10/13</td>
<td>10/13</td>
<td>10/13</td>
<td>10/13</td>
</tr>
<tr>
<td>5 Marine 4</td>
<td>0.30</td>
<td>0.55</td>
<td>NR</td>
<td>49</td>
<td>20 or 13+3</td>
<td>13/17</td>
<td>30</td>
<td>15/19</td>
<td>10/2</td>
<td>15/19</td>
</tr>
<tr>
<td>6</td>
<td>0.30</td>
<td>0.55</td>
<td>NR</td>
<td>49</td>
<td>20+5 or 13+10</td>
<td>15/20</td>
<td>30</td>
<td>15/19</td>
<td>10/3</td>
<td>15/19</td>
</tr>
<tr>
<td>7 and 8</td>
<td>0.30</td>
<td>0.55</td>
<td>NR</td>
<td>49</td>
<td>20+5 or 13+10</td>
<td>19/21</td>
<td>30</td>
<td>15/19</td>
<td>10/3</td>
<td>15/19</td>
</tr>
</tbody>
</table>

NR = Not Required. For SI: 1 foot = 304.8 mm.

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

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

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

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

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

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

g. Alternatively, insulation sufficient to fill the framing cavity and providing not less than an $R$-value of R-19.

h. The first value is cavity insulation, the second value is continuous insulation. Therefore, as an example, “13+5” means R-13 cavity insulation plus R-5 continuous insulation.
**TABLE R402.1.4 (IRC N1102.1.4)**

**EQUIVALENT U-FACTORS**

<table>
<thead>
<tr>
<th>CLIMATEZONE</th>
<th>FENESTRATION U-FACTOR</th>
<th>SKYLIGHT U-FACTOR</th>
<th>CEILING U-FACTOR</th>
<th>FRAMEWALL U-FACTOR</th>
<th>MASS WALL U-FACTOR</th>
<th>FLOOR U-FACTOR</th>
<th>BASEMENTWALL U-FACTOR</th>
<th>CRAWLSPACE WALL U-FACTOR</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0.50</td>
<td>0.75</td>
<td>0.035</td>
<td>0.084</td>
<td>0.197</td>
<td>0.064</td>
<td>0.360</td>
<td>0.477</td>
</tr>
<tr>
<td>2</td>
<td>0.40</td>
<td>0.65</td>
<td>0.030</td>
<td>0.084</td>
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a. Nonfenestration U-factors shall be obtained from measurement, calculation or an approved source.
b. Mass walls shall be in accordance with Section R402.2.5. Where more than half the insulation is on the interior, the mass wall U-factors shall not exceed 0.17 in Climate Zone 1, 0.14 in Climate Zone 2, 0.12 in Climate Zone 3, 0.087 in Climate Zone 4 except Marine, 0.065 in Climate Zone 5 and Marine 4, and 0.057 in Climate Zones 6 through 8.
c. In warm-humid locations as defined by Figure R301.1 and Table R301.1, the basement wall U-factor shall not exceed 0.360.
d. A maximum U-factor of 0.32 shall apply in Climate Zone Marine 4 and Climate Zones 5 through 8 to vertical fenestration products installed in buildings located:

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i. Mass walls shall be in accordance with Section R402.2.5. The second R-value applies where more than half of the insulation is on the interior of the mass wall.

ii. A maximum U-factor of 0.32 shall apply in Climate Zone Marine 4 and Climate Zones 5 through 8 to vertical fenestration products installed in buildings located:

1. Above 4000 feet in elevation above sea level, or
2. In windborne debris regions where protection of openings is required under Section R301.2.2 of the International Residential Code.
1. Above 4000 feet in elevation above sea level, or
2. In windborne debris regions where protection of openings is required under Section R301.2.1.2 of the International Residential Code.

Reason: High altitude products generally require breather or capillary tubes in the insulating glass unit to allow pressure equalization when the products are transported to higher elevations for installation. The pressure equalization is necessary to avoid breakage. However, the tubes eliminate the ability to use gas fills commonly used to achieve higher levels of thermal performance. Meanwhile, windborne debris protection requirements for fenestration are typically met by the use of laminated glass which reduces the gap width in the insulating glass unit and thus the thermal performance. This footnote provides a reasonably limited and needed exception for products installed above 4000 ft above sea level in climate zones Marine4 zones 5-8, and for products that must meet windborne debris protection requirements.

Cost Impact: The code change proposal will decrease the cost of construction
This will avoid the need for costly redesign of products, e.g., larger frame sizes for impact resistant fenestration, or the need for fenestration products to be installed above 4000 ft to be manufactured in a location above 4000 ft.
RE42-19
IECC: R402.2.1 (IRC N1102.2.1), R402.2.2 (IRC N1102.2.2)

Proponent: Darren Meyers, P.E., IECC LLC representing the National Roofing Contractors Association, representing the National Roofing Contractors Association (dmeyers@ieccode.com)

2018 International Energy Conservation Code
Revise as follows:

R402.2.1 (IRC N1102.2.1) Ceilings with attic spaces. Where Section R402.1.2 requires R-38 insulation in the ceiling attic, installing R-30 over 100 percent of the ceiling attic area requiring insulation shall satisfy the requirement for R-38 wherever the full height of uncompressed R-30 insulation extends over the wall top plate at the eaves. Where Section R402.1.2 requires R-49 insulation in the ceiling attic, installing R-38 over 100 percent of the ceiling attic area requiring insulation shall satisfy the requirement for R-49 insulation wherever the full height of uncompressed R-38 insulation extends over the wall top plate at the eaves. This reduction shall not apply to the U-factor alternative approach in Section R402.1.4 and the Total UA alternative in Section R402.1.5.

R402.2.2 (IRC N1102.2.2) Ceilings without attic spaces. Where Section R402.1.2 requires insulation R-values greater than R-30 in the ceiling interstitial space above a ceiling and below the structural roof deck and the design of the roof/ceiling assembly does not allow sufficient space for the required insulation, the minimum required insulation R-value for such roof/ceiling assemblies shall be R-30. Insulation shall extend over the top of the wall plate to the outer edge of such plate and shall not be compressed. This reduction of insulation from the requirements of Section R402.1.2 shall be limited to 500 square feet (46 m2) or 20 percent of the total insulated ceiling area, whichever is less. This reduction shall not apply to the U-factor alternative approach in Section R402.1.4 and the Total UA alternative in Section R402.1.5.

Reason: This code change proposal is intended to provide clarity consistent with roofing terminology used every day by roofing industry- and design-professionals across the country.

Cost Impact: The code change proposal will not increase or decrease the cost of construction. There is no cost implication aligned with this proposal. Rather, it is an exercise steeped in clarification and consistency across the ICC Family of International Codes.
2018 International Energy Conservation Code

Revise as follows:

R103.2 (IRC N1101.5) Information on construction documents. Construction documents shall be drawn to scale on suitable material. Electronic media documents are permitted to be submitted where approved by the code official. Construction documents shall be of sufficient clarity to indicate the location, nature and extent of the work proposed, and show in sufficient detail pertinent data and features of the building, systems and equipment as herein governed. Details shall include the following as applicable:

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

SECTION R202 (IRC N1101.6)
GENERAL DEFINITIONS

Add new definition as follows:

BATCH SAMPLING. Verification of energy code requirements when fewer than 100 percent of every dwelling or dwelling unit, within a sampled project are inspected, tested, or modeled for compliance.

Add new text as follows:

R401.2.2 (IRC N1101.13.2) Batch sampling. Batch sampling to determine energy code compliance shall only be allowed for stacked multiple-family dwelling unit projects within the same subdivision or community.

Exceptions:

1. Where sampling of energy compliance items for other than sections R402.4 and R403.3.3, an approved sampling plan shall be included in the construction documents and approved by the code official.
2. Where sampling is proposed for other than stacked multiple-family dwelling unit projects, an approved sampling plan shall be included in the construction documents and approved by the code official.

R401.2.2.1 (N1101.13.2.2.1) Sampling process. The sampling process shall follow these steps.

1. After five consecutive dwellings or dwelling units demonstrate compliance with the code without an incidence of failure, then only one dwelling or dwelling unit in subsequent batches of five dwelling units is required to demonstrate compliance through testing and inspection.
2. The remaining four units in the sampling batch shall be considered to be in compliance with the code when the one sampled unit in the batch of five dwelling units has demonstrated compliance.
3. Where the one dwelling or dwelling unit tested and inspected in the batch of five fails to demonstrate compliance with the code then that unit and 3 consecutive dwellings or dwelling units shall demonstrate compliance without incidence of failure before batch sampling is allowed to continue.

Exception: An approved sampling plan shall be used as an alternative to Section R401.2.2.1.

Revise as follows:

R405.4.2 (IRC N1105.4.2) Compliance report. Compliance software tools shall generate a report that documents that the proposed design complies with Section R405.3. A compliance report on the proposed design shall be submitted with the application for the building permit. Upon completion of the building, a compliance report based on the as-built condition of the building shall be submitted to the code official before a certificate of occupancy is issued. Compliance reports shall include information in accordance with Sections R405.4.2.1 and R405.4.2.2. Where the proposed design of a building could be built on different sites where the cardinal orientation of the building on each site is different, compliance of the proposed design for the purposes of
the application for the building permit shall be based on the worst-case orientation, worst-case configuration, worst-case building air leakage and worst-case duct leakage. Such worst-case parameters shall be used as inputs to the compliance software for energy analysis.

Reason: Currently, sampling is only addressed within the Simulated Performance Path section R405 of the IECC. It states, “Batch sampling of buildings to determine energy code compliance shall only be allowed for stacked multiple-family units.” Narrowing the allowance for sampling to stacked multi-family units makes a lot of sense but narrowing sampling to only the Simulated Performance path does not. This proposal broadens the ability to sample dwelling units regardless of the pathway used to navigate the IECC.

In researching this proposal, it became evident that sampling means something different to the code compliance community than it does to the verification and builder program community. My discussions with the code compliance community indicated that they believe that sampling is only a tool that is used for lessening the requirement of blower door and duct leakage testing every permitted dwelling unit. The verification and builder program community, on the other hand, uses sampling to verify compliance of any requirement of compliance. Therefore, this proposal states that sampling used for anything other than blower door or duct leakage testing must have a sampling plan submitted at permitting that is approved by the authority having jurisdiction. In this way, it is ultimately up to the jurisdiction to determine their comfort level with the use of sampling for other code compliance feature and building types than diagnostic testing and stacked multi-family dwelling units.

Currently, the code does not define in any way what sampling means. The second half of this proposal defines the minimum requirements for sampling, which not only offers guidance to the jurisdiction for what to expect but also offers a baseline for which to assess the merits of submitted sampling plans which may be submitted to potentially broaden the scope of what could be sampled.

In specific markets, such as Phoenix Arizona, sampling is a common occurrence and in others, it never occurs. This proposal ensures that regardless of where it is used that there is a common understanding of what it is and how it can be used for code compliance in comparison to compliance with programs such as EnergyStar or LEED for homes.

Cost Impact: The code change proposal will not increase or decrease the cost of construction.

It is not clear how to assess the cost impact of a proposal like this as it depends completely on the quality of the installation of the code required item. If everything passes inspection the first time it can save money due to requiring fewer inspections, but if something fails it must be tested 3 more times and it could increase cost. The most important aspect of the proposal is not associated with cost it is associated with the ability to use sampling regardless of the compliance path chosen.

Proposal # 4805
2018 International Energy Conservation Code

Revise as follows:

R402.2.3 (IRC N1102.2.3) Eave baffle. For air-permeable insulations in vented attics, a baffle shall be installed adjacent to soffit and eave vents. Baffles shall maintain a net free area opening equal or greater than the size of the vent. The baffle shall extend over the top of the attic insulation. The baffle shall be permitted to be any solid material. The baffle shall be installed to the outer edge of the exterior wall top plate so as to provide maximum space for attic insulation coverage over the top plate. Where soffit venting is not continuous, baffles shall be installed continuously to prevent ventilation air in the eave soffit from bypassing the baffle.

Reason: The objective of the attic eave baffles is to provide a continuous pathway for air flow from the eave vent to the ridge or pot vent located higher up on the roof without allowing air to migrate through the insulation that is used, thus reducing the insulations ability to retard heat flow. In order to ventilate the attic according to the IRC section R806.2 a minimum net free area is called out. For air to go out of the roof vent air must enter through the eave vent and if the net free area is not equal at the eave vent and the path the air takes from the eave to the roof vent above the insulation, the IRC required ventilation can not occur. Thus, the inclusion of the language “net free area” for the defined ventilation created with the baffle.

In the IECC section R402.2.2 the code states “Insulation shall extend over the top plate of the wall plate to the outer edge of such plate and shall not be compressed.” This section is discussing installation not related R-value requirements that may change depending on the IECC compliance pathway. This proposal adds an installation instruction to better ensure that attic insulation can be installed, as much as possible over, the top plate to achieve the energy savings of the installation.

IRC Section R806.3 states that, “Where eave or cornice vents are installed, blocking, bridging and insulation shall not block the free flow of air.” When air enters non-continuous attic eave vents and fills the eave with air that air travels both through the designated space created by the eave baffles and through the surrounding insulation in adjacent bays. The insulation is slowing or “blocking” the free flow of air that section R806.3 is trying to preserve. In addition, ventilated attics use the depth of the installed insulation to overcome the performance implications of not being able to enclose the insulation on the attic ventilation side. The intrusion of eave vent ventilation into the attic insulation at the drywall plane separating the attic from conditioned space below degrades the ability of the insulation to inhibit the flow of energy and achieve the desired R-value. This proposal uses continuous baffles to better ensure that eave ventilation passes cleanly over the top of all installed insulation bettering the performance of the ventilation system and the installed insulation.

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

Depending on the design of the attic eave ventilation system minimal cost increases could be incurred from requiring the installation of continuous soffit baffles. However, cost of ownership would go down in relationship to the first cost as the ability of the insulation to reduce heat lose would increase.

Proposal # 4800

RE44-19
IECC: R402.2.3 (IRC N1102.2.3)

Proponent: Shaunna Mozingo, City of Westminster, representing Colorado Chapter of ICC Energy Code Development Committee
(smozingo@cityofwestminster.us)

2018 International Energy Conservation Code

Revise as follows:

R402.2.3 (IRC N1102.2.3) Eave baffle. (Mandatory) For air-permeable insulations in vented attics, a baffle shall be installed adjacent to soffit and eave vents. Baffles shall maintain an opening equal or greater than the size of the vent. The baffle shall extend over the top of the attic insulation. The baffle shall be permitted to be any solid material.

Reason: Because Section R402.2 Specific Insulation Requirements (Prescriptive), is marked prescriptive R402.2.3 automatically becomes prescriptive but there is no reason that Eave Baffles should be allowed to be traded off. We understand that the SEHPCAC committee is putting forth a proposal to revise all of the prescriptive verses mandatory requirements, which we approve of, but it may not pass, so we are doing this as a back up plan.

Cost Impact: The code change proposal will increase the cost of construction
Truly there should be no cost impact because eave baffles should have always been installed. However, if someone was trading them off there would be a cost for installing a baffle now. The cost is dependent on the material used, it could be as simple as a piece of cardboard. So, the cost would be for the labor.
2018 International Energy Conservation Code

Add new text as follows:

R402.2.4 (IRC N1102.2.4) Access hatches and doors. Access hatches and doors from conditioned to unconditioned spaces such as attics and crawlspaces shall be insulated to the same level required for the wall or ceiling R-value in Table R402.1.2 in which they are installed.

**Exception:** Vertical doors providing access from conditioned spaces to unconditioned spaces that comply with the fenestration requirements of Table R402.1.2 based on the applicable climate zone specified in Chapter 3.

Revise as follows:

R402.2.4 (IRC N1102.2.4) R402.2.4.1 (IRC N1102.4.1) Access hatches and doors, doors installation (Mandatory). Access hatches and doors from conditioned spaces to unconditioned spaces such as attics and crawl spaces shall be weatherstripped and insulated to a level equivalent to the insulation on the surrounding surfaces. Access that prevents damaging or compressing the insulation shall be provided to all equipment. Where loose-fill insulation is installed, a wood-framed or equivalent baffle or retainer shall be installed to prevent the loose-fill insulation from spilling into the living space when the attic access is opened. The baffle or retainer shall provide a permanent means of maintaining the installed R-value of the loose-fill insulation.

**Exception:** Vertical doors providing access from conditioned spaces to unconditioned spaces that comply with the fenestration requirements of Table R402.1.2 based on the applicable climate zone specified in Chapter 3.

**Reason:** R402.2.4 includes both prescriptive provisions (required insulation levels) and non-tradeable (mandatory) installation specifications. This proposal does not add new requirements; rather, it separates the prescriptive and mandatory provisions into separate sections.

The insulation installation requirements of new Sec. R402.2.4.1 have no value or metric that can be used for modeling purposes; they are non-tradeable (mandatory).

Note that the SEHPCAC has a proposal to eliminate the use of the labels “prescriptive” and “mandatory” in favor of a tabular method of identifying non-tradeable requirements. If that proposal is successful, ICC staff have stated that sections being individually approved to be labeled as ‘mandatory’ will instead have their respective section numbers added to the new C407.2 table of requirements that are non-tradeable in the performance path.

This proposal is submitted by the ICC Sustainable, Energy and High Performance Code Action Committee (SEHPCAC). The SEHPCAC was established by the ICC Board of Directors to pursue opportunities to improve and enhance International Codes with regard to sustainability, energy and high performance as it relates to the built environment included, but not limited to, how these criteria relate to the International Green Construction Code (IgCC) and the International Energy Conservation Code (IECC). In 2018-2019, the SEHPCAC has held five two- or three-day open meetings and numerous workgroup calls, to discuss and debate proposed changes and public comments. Attendees at the meetings and calls included members of the SEHPCAC as well as any interested parties. Related documentation and reports are posted on the SEHPCAC website at: http://www.iccsafe.org/cs/SEHPCAC/Pages/default.aspx

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

The code change may increase construction costs for a subset of buildings that may have been designed using the Total Building Performance or EIR compliance methods that included did not include weatherstripping or baffles around the applicable hatches and doors.
2018 International Energy Conservation Code

Revise as follows:

R402.2.4 (IRC N1102.2.4) Access hatches and doors. Access doors from conditioned spaces to unconditioned spaces such as attics and crawl spaces shall be weatherstripped and insulated to a level equivalent to the insulation on the surrounding surfaces. Access that prevents damaging or compressing the insulation shall be provided to all equipment. Where loose-fill insulation is installed, a wood-framed or equivalent baffle or retainer shall be installed to prevent the loose-fill insulation from spilling into the living space when the attic access is opened. The baffle or retainer shall provide a permanent means of maintaining the installed R-value of the loose-fill insulation.

**Exception Exceptions:**

1. Vertical doors providing access from conditioned spaces to unconditioned spaces that comply with the fenestration requirements of Table R402.1.2 based on the applicable climate zone specified in Chapter 3.
2. In Climate Zones 1 through 4 horizontal pull-down stair-type access hatches in ceiling assemblies that provide access from conditioned to unconditioned spaces shall not be required to comply with the insulation level of the surrounding surfaces provided the hatch meets all of the following:
   - The average U-factor of the hatch shall not exceed U-0.10 or have an average insulation R-value less than R-10.
   - Not less than 75 percent of the panel area shall have an insulation R-value of at least R-13.
   - The net area of the framed opening shall be less than or equal to 13.5 square feet, and
   - The perimeter of the hatch edge shall be weatherstripped.

The reduction shall not apply to the U-factor alternative approach in Section R402.1.4 or the total UA alternative in Section R402.1.5.

**Reason:** A code change similar to this proposal was submitted to the IECC and IRC during the 2016 Group B code cycle (RE50-16). At the Code Action Hearing in Louisville, KY the IECC Code Development Committee (CDC) saw the logic of the proposal and recommended the change for Approval As Submitted. The CDC reason given was:

The practical implications outweigh the minimal loss of insulation R-value. Experience with products that can comply with these requirements is a superior method as compared what has been done in the past and provides for a long-term solution.

Their reason is consistent with our experience that the added insulation requirement in section R402.2.4 (N1102.2.4) is frequently achieved with “field crafted detachable apparatuses”. Unfortunately, over time these are commonly discarded or worse, set aside compressing adjacent ceiling insulation thus defeating the intended benefit. The objective of this proposal is to address this field modification issue and provide for a more permanent installed solution.

During the 2015 ICC code development cycle for the IRC and the IECC an exception was added to the ceiling insulation requirements for vertical doors providing access to attic areas in IECC Section R402.2.4 and IRC Section N1102.2.4. This exception was based on the premise that vertical attic access doors between conditioned and unconditioned spaces can be treated as fenestration. Horizontally positioned attic access hatches are a similar issue. These horizontal hatches are being required to have insulation levels that match the surrounding ceiling which is significantly more stringent than skylight fenestration products located in these same ceiling assemblies.

For example, in Table R402.1.2 (N1102.1.2) Skylights are required to meet a U-factor that ranges from 0.75 in Climate Zone 1 to 0.55 in Climate Zone 8. In addition, Section R402.3.3 (N1102.3.3) allows up to 15 square feet of the fenestration per dwelling unit (which includes skylights) to be exempt from the requirements in Table R402.1.2 (N1102.1.2). It does not make sense to require R-30 to R-49 insulation for a pull down stair type access hatch in an insulated ceiling when one can have a skylight up to 15 square feet in area that is exempt from the envelope requirements or that has a U-FACTOR of 0.55-0.75 (less than R-2). Insulating pull down stair access hatches to the levels specified in N1102.2.4 (R402.2.4), compared to the skylights insulation requirements is expensive, and in many cases not practical.

Because affordable, pre-manufactured pull-down stair access systems are not readily available to meet the R-30 to R-49 target field customization of access hatches is sometimes employed to achieve these performance levels. Inspection and verification for compliance becomes a challenge. As noted previously, long term system performance of these field customized entry devices may also vary. Commonly these “field crafted detachable apparatuses” are designed to be removed for attic access and placed on the adjacent attic joists. This results in the insulation being compressed thus reducing its effectiveness. Also providing sufficient air sealing around the hatch that remains durable long term is difficult. Finally, removal of the insulated covers for access may present a safety hazard to service personnel, inspectors and building owners having to stand on ladders while removing the hatches.
Quality standardized manufactured pull down stair systems however provide a safer, permanent access with proven performance for the life of the structure. Factory built energy rated access systems provide consistent air sealing performance and ensure consistent energy performance while helping to maintain air quality through reduced air infiltration.

This proposal provides a solution by permitting a reasonable reduction in the insulation values for pull down stair access hatches that are less than or equal to 13.5 square feet (approximately 30” X 64”) in attic ceilings. This maximum size accommodates most manufactured products available. The U-value specified at U-0.10 is less stringent than the U-values specified for the insulated ceilings but is far more stringent than those permitted for skylights in all Climate Zones. Too the size limit is more stringent than that permitted for skylights which can have one unit up to 15 square feet in size exempted from the code requirements while all other skylights are less stringent than the pull down stair assembly proposed. Finally, the proposal also does not allow this reduction to be factored into the U-Factor alternative calculation procedure in R4002.1.4 (N1102.1.4) or the total UA alternative procedure in R402.1.5 (N1102.1.5). This is consistent with the limitations in Section R402.2.1 (N1102.2.1) for ceilings with attic spaces and in Section R402.3.3 (N1102.3.3) for skylights.

Though the previous code change RE50-16 was recommended for approval as submitted a public comment was submitted. At the Public Comment Hearing (PCH) in Kansas City, MO the commenter raised concerns about the impact of such reduced insulation levels in cold climates. The membership overturned the action of the committee and RE50-16 was disapproved.

The intent of this proposal is the same as the original proposal previously approved by the IECC Code Development Committee with two basic improvements.

1. The criteria that horizontal pull-down stair-type access hatches must meet has been formatted in a list format to aid the code user in determining the requirements to be met by this exception.

2. The reduced insulation level for these horizontal pull-down stair-type access hatches is limited to Climate Zones 1-4 in response to previous objections for this exception in cold climates.

Recommend the IECC Code Development Committee again take action to Approve As Submitted.

Cost Impact: The code change proposal will decrease the cost of construction
The reduced cost of field installed apparatuses and insulation will offset the cost of the pull-down stair
2018 International Energy Conservation Code

Revise as follows:

R402.2.4 (IRC N1102.2.4) Access hatches and doors. **(Mandatory)** Access doors from *conditioned spaces* to *unconditioned spaces* such as attics and crawl spaces shall be weatherstripped and insulated to a level equivalent to the insulation on the surrounding surfaces. Access that prevents damaging or compressing the insulation shall be provided to all equipment. Where loose-fill insulation is installed, a wood-framed or equivalent baffle or retainer shall be installed to prevent the loose-fill insulation from spilling into the living space when the attic access is opened. The baffle or retainer shall provide a permanent means of maintaining the installed R-value of the loose-fill insulation.

Exception: Vertical doors providing access from *conditioned spaces* to *unconditioned spaces* that comply with the fenestration requirements of Table R402.1.2 based on the applicable *climate zone* specified in Chapter 3.

Reason: Because Section R402.2 Specific Insulation Requirements (Prescriptive), is marked prescriptive R402.2.4 automatically becomes prescriptive but there is no reason that Access Hatches and Door Sealing and Insulation level should be allowed to be traded off. We understand that the SEHPCAC committee is putting forth a proposal to revise all of the prescriptive verses mandatory requirements, which we approve of, but it may not pass, so we are doing this as a back up plan.

Cost Impact: The code change proposal will increase the cost of construction. There is no reason that this should increase cost because it's mandatory that you seal the thermal envelope, and you always have to provide insulation in a vented attic, the level just depends on which path you choose. But, people will argue that since it was prescriptive you didn't really have to do it, so there could be a charge for weather stripping and insulation, amount dependent on material used.
2018 International Energy Conservation Code

Revise as follows:

R402.2.4 (IRC N1102.2.4) Access hatch doors and doors, insulation retention.

Horizontal or vertical access doors from conditioned spaces to unconditioned spaces such as attics and crawl spaces shall be weatherstripped and insulated to a level equivalent to the insulation on the surrounding surfaces. Access that prevents damaging or compressing the insulation shall be provided to all equipment. Where loose-fill insulation is installed, a wood-framed or equivalent baffle, retainer, or retainer dam shall be installed to prevent the loose-fill insulation from spilling into the living space when the attic access is opened, from higher to lower sections of the attic, and from attics covering conditioned spaces to unconditioned spaces. The baffle or retainer shall provide a permanent means of maintaining the installed R-value of the loose-fill insulation.

Exception: Vertical doors providing access from conditioned spaces to unconditioned spaces that comply with the fenestration requirements of Table R402.1.2 based on the applicable climate zone specified in Chapter 3.

Reason: This section of the code is solely about the installation of insulation in the attic and retaining it in its installed location to ensure that it performs as intended by the manufacturer. The use of wooden or equivalent baffle retainer or insulation dam to hold insulation in place at the attic hatch needs to be expanded to include insulation that is installed in raised ceilings or separating conditioned from unconditioned spaces. The inclusion of additional language to this proposal improves how insulation will perform when installed in these locations.

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

Attention to detail in installation dams and baffles will initially take slightly more labor but will be negligible once methods are in place to do it right the first time. The cost of ownership and cost of builder warranty is lowered.
Proponent: Felix Zemel, representing ICC Region 6 -- North East Regional Coalition (felix@pracademicsolutions.com); Peter Zvingilas, ICC Region 6- North East Regional Coalition, Town of Groton and Voluntown CT (pzvingilas@voluntown.gov)

2018 International Energy Conservation Code

Revise as follows:

R402.5 (IRC N1102.2.5) Mass walls. Mass walls where used as a component of the building thermal envelope shall be one of the following:

1. Above-ground walls of concrete block, concrete, insulated concrete form, masonry cavity, brick but not brick veneer, adobe, compressed earth block, rammed earth, solid timber, mass timber, or solid logs.
2. Any wall having a heat capacity greater than or equal to 6 Btu/ft² °F (123 kJ/m² K).

Add new definition as follows:

MASS TIMBER Structural elements of Type IV construction primarily of solid, built-up, panelized or engineered wood products that meet minimum cross-section dimensions of Type IV construction, as defined in the International Building Code

Reason: This new term, as approved in the 2018 Group A Code Hearings for the IBC, adds a new type of construction into the residential provisions of the IECC. By adding this definition, the subsequent definitions of mass walls can be updated to include mass walls. Addition of mass timber into the prescriptive list of materials that are considered mass walls will make it possible for any material meeting the IBC definition of mass timber to be used without additional testing for heat capacity.

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

By adding mass timber into the prescriptive list of materials constituting a mass wall, builders will be able to use mass timber for building envelope features without requiring additional testing for heat capacity of the material. By saving on this testing, the cost of construction is expected to decrease.
### 2018 International Energy Conservation Code

Revisit as follows:

#### TABLE R402.6 (IRC N1102.2.6)

**STEEL-FRAME CEILING, WALL AND FLOOR INSULATION R-VALUES**

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<tbody>
<tr>
<td><strong>Steel Truss Ceilings</strong>&lt;sup&gt;b&lt;/sup&gt;</td>
<td></td>
</tr>
<tr>
<td>R-30</td>
<td>R-38 or R-30 + 3 or R-26 + 5</td>
</tr>
<tr>
<td>R-38</td>
<td>R-49 or R-38 + 3</td>
</tr>
<tr>
<td>R-49</td>
<td>R-38 + 5</td>
</tr>
<tr>
<td><strong>Steel Joist Ceilings</strong>&lt;sup&gt;b&lt;/sup&gt;</td>
<td></td>
</tr>
<tr>
<td>R-30</td>
<td>R-38 in 2 × 4 or 2 × 6 or 2 × 8 R-49 in any framing</td>
</tr>
<tr>
<td>R-38</td>
<td>R-49 in 2 × 4 or 2 × 6 or 2 × 8 or 2 × 10</td>
</tr>
<tr>
<td><strong>Steel-Framed Wall, 16 inches on center</strong></td>
<td></td>
</tr>
<tr>
<td>R-13</td>
<td>R-13 + 4.2 or R-21 + 2.8 or R-0 + 9.3 or R-15 + 3.8 or R-21 + 3.1</td>
</tr>
<tr>
<td>R-13 + 3</td>
<td>R-0 + 11.2 or R-13 + 6.1 or R-15 + 5.7 or R-19 + 5.0 or R-21 + 4.7</td>
</tr>
<tr>
<td>R-13+5</td>
<td>R-0+15 or R-13+9 or R-15+8.5 or R19+8 or R-21+7</td>
</tr>
<tr>
<td>R-13+10</td>
<td>R0+20 or R-13+15 or R-15+14 or R19+13 or R-21+13</td>
</tr>
<tr>
<td>R-20</td>
<td>R-0 + 14.0 or R-13 + 8.9 or R-15 + 8.5 or R-19 + 7.8 or R-21 + 6.2 or R-21 + 7.5</td>
</tr>
<tr>
<td>R-20 + 5</td>
<td>R-13 + 12.7 or R-15 + 12.3 or R-19 + 11.6 or R-21 + 11.3 or R-25 + 10.9</td>
</tr>
<tr>
<td>R-21</td>
<td>R-0 + 14.6 or R-13 + 9.5 or R-15 + 9.1 or R-19 + 8.4 or R-21 + 8.1 or R-25 + 7.7</td>
</tr>
<tr>
<td><strong>Steel Framed Wall, 24 inches on center</strong></td>
<td></td>
</tr>
<tr>
<td>R-13</td>
<td>R-0 + 9.3 or R-13 + 3.0 or R-15 + 2.4</td>
</tr>
<tr>
<td>R-13 + 3</td>
<td>R-0 + 11.2 or R-13 + 4.9 or R-15 + 4.3 or R-19 + 3.5 or R-21 + 3.1</td>
</tr>
<tr>
<td>R-13+5</td>
<td>R-0+15 or R-13+7.5 or R-15+7 or R-19+6 or R-21+6</td>
</tr>
<tr>
<td>R-13+10</td>
<td>R-0+20 or R-13+13 or R-15+12 or R-19+11 or R-21+11</td>
</tr>
<tr>
<td>R-20</td>
<td>R-0 + 14.0 or R-13 + 7.7 or R-15 + 7.1 or R-19 + 6.3 or R-21 + 5.9</td>
</tr>
<tr>
<td>R-20 + 5</td>
<td>R-13 + 11.5 or R-15 + 10.9 or R-19 + 10.1 or R-21 + 9.7 or R-25 + 9.1</td>
</tr>
<tr>
<td>R-21</td>
<td>R-0 + 14.6 or R-13 + 8.3 or R-15 + 7.7 or R-19 + 6.9 or R-21 + 6.5 or R-25 + 5.9</td>
</tr>
<tr>
<td><strong>Steel Joist Floor</strong></td>
<td></td>
</tr>
<tr>
<td>R-13</td>
<td>R-19 in 2 × 6, or R-19 + 6 in 2 × 8 or 2 × 10</td>
</tr>
<tr>
<td>R-19</td>
<td>R-19 + 6 in 2 × 6, or R-19 + 12 in 2 × 8 or 2 × 10</td>
</tr>
</tbody>
</table>

a. The first value is cavity insulation R-value, the second value is continuous insulation R-value. Therefore, for example, “R-30+3” means R-30 cavity insulation plus R-3 continuous insulation.

b. Insulation exceeding the height of the framing shall cover the framing.

**Reason:** Commenter's Reason: This proposal expands the listing for cold-formed steel equivalent R-values in order to coordinate with Tables R402.1.2 and N1102.1.2 entitled “Insulation and Fenestration Requirements by Component”.

**History and Selection of Methodology:** The RESCheck methodology was originally selected for determining equivalency since its methodology for calculating wood and steel framed U-factors has served as the basis for U-factor calculations of these assemblies since the publication of the 2004 IECC Supplement Edition. This approach was again used for consistency in this code change proposal.

**Details of Calculations and Assumptions:** The U-factors from Tables R402.1.4 (and N1102.1.4) for wood framed walls were used as the benchmark to determine the equivalent insulation (Cavity and continuous) R-values for cold-formed steel framing. The cold-formed steel framed walls at 16” o.c. and 24” o.c. were then calculated where cavity and exterior insulation were added in order to achieve near equivalent U-factors as...
for wood framed wall assemblies. This resulted in R-values and U-factors for cold-formed steel framed walls that can be considered comparable to wood wall assemblies.

In addition to the above modification, we are also proposing the deletion of the R-19+6.2 assembly configuration for the Wood 16 O/C category R-20. After a re-analysis we found that the U-factor is higher than the wood assembly U-factor comparison sufficient enough to recommend its departure.

**Conclusion:** Adopting the proposed modifications is intended to provide related prescriptive for cold-formed steel framed assembly options consistent with the options listed for wood framed assemblies in the opaque thermal envelope tables.


**Cost Impact:** The code change proposal will not increase or decrease the cost of construction. This section provides information that was not previously set forth in the code, and does not change the requirements of current code, thus there is no cost impact when compared with present requirements.
2018 International Energy Conservation Code
Delete without substitution:

R402.2.7 Walls with partial structural sheathing. Where Section R402.1.2 requires continuous insulation on exterior walls and structural sheathing covers 40 percent or less of the gross area of all exterior walls, the required continuous insulation R-value shall be permitted to be reduced by an amount necessary, but not more than R-3 to result in a consistent total sheathing thickness on areas of the walls covered by structural sheathing. This reduction shall not apply to the U-factor alternative in Section R402.1.4 and the Total UA alternative in Section R402.1.5.

Reason: The purpose of this code change proposal is to improve efficiency by eliminating an unnecessary prescriptive exception to the wall insulation requirements. The IECC currently allows an exception to the otherwise reasonable wall insulation requirements, which results in decreased energy efficiency in up to 40% of the wall area without any corresponding improvements elsewhere in the building.
We do not believe it is appropriate to weaken the code simply because of a design choice made by the builder, even if it is a common construction practice. Given the broad range of trade-off options available through the Total UA path, DOE’s REScheck software, the performance path, and the Energy Rating Index, we believe it is no longer necessary to carve out specific exceptions like this when an energy-neutral trade-off could easily be performed in one of these alternative paths.

Cost Impact: The code change proposal will increase the cost of construction
Construction costs could be increased for the subset of homes that might have taken advantage of this exception in the prescriptive path because it will require the installation of insulation sufficient to meet the R-value requirement in Table R402.1.2. However, this change will not increase costs for homes built to all other compliance paths in the IECC, since the footnote exception already does not apply to those homes. We believe the elimination of this exception will provide homeowners with the superior energy and cost-savings they expect from a code-compliant home.
**2018 International Energy Conservation Code**

**SECTION R402**

**BUILDING THERMAL ENVELOPE**

Revise as follows:

R402.2.8 (N1102.2.8) **Floors**. Floor framing-cavity insulation shall comply with one of the following:

1. Insulation shall be installed to maintain permanent contact with the underside of the subfloor decking in accordance with manufacturer instructions to maintain required R-value or readily fill the available cavity space.
2. Floor framing cavity insulation shall be permitted to be in contact with the top side of sheathing separating the cavity and the unconditioned space below. Insulation shall extend from the bottom to the top of all perimeter floor framing members and the framing members shall be air sealed.
3. A combination of cavity and continuous insulation shall be installed so that the cavity insulation is

**Exception:** As an alternative, the floor framing-cavity insulation shall be in contact with the top side of sheathing or the continuous insulation that is installed on the bottom side of the floor framing where combined with insulation that meets or exceeds the minimum wood frame wall R-value in Table R402.1.2 and that extends separating the cavity and the unconditioned space below. The combined R-value of the cavity and continuous insulation shall equal the required R-value for floors. Insulation shall extend from the bottom to the top of all perimeter floor framing members and the framing members shall be air sealed.

**Reason:** With the introduction of the exception in this section of the code in the 2015 IECC, it has become exceedingly difficult to not only understand what installations are allowed but how to explain and enforce what is allowed. This revision of the language does not change how insulation in floor systems are currently allowed to be installed but clarifies and simplifies the language. To better understand the requirements, I have included the diagrams below:
Cost Impact: The code change proposal will not increase or decrease the cost of construction. There is not cost impact associated with this proposal as all installations are currently allowed in the IECC.
RE54-19
IECC: R402.2.9 (IRC N1102.2.9)

Proponent: Robby Schwarz, EnergyLogic, representing EnergyLogic (robby@nrglogic.com)

2018 International Energy Conservation Code
Revise as follows:

R402.2.9 (IRC N1102.2.9) Basement walls. Walls associated with conditioned basements shall be insulated from the top of the basement wall down to 10 feet (3048 mm) below grade or to the basement floor, whichever is less. Walls associated with unconditioned basements shall comply with this requirement except where the floor overhead is insulated in accordance with Sections R402.1.2 and R402.2.8. Comply with the following requirements:

1. Basement walls that define the building thermal envelope shall be insulated. The R-value shall be in accordance with the compliance path that is defined at the time of obtaining the building permit. Unconditioned basements shall comply with the floor insulation requirements of Section R402.2.8.

2. Unfinished basement walls that define the building thermal envelope shall have insulation that is permanently fastened to the wall. The insulation shall cover the exposed portion of the top of the foundation wall not covered by the sill plate, and extend downward to the finished floor below.

3. Finished basement walls that define the building thermal envelope shall be insulated with material that fully fills the framed stud cavity of the finished wall or material that upon installation fully fills the available space. A 1 in. (25 mm) gap is allowed between the framed cavity and insulation, and the concrete foundation wall. Insulation shall be installed between framed bottom plates and the foundation floor when floating walls are used. Insulation shall be installed at the top of the foundation wall not covered by the sill plate.

Reason: This section of the code defines required installation requirements of the code that are not defined by manufacturer instructions. Since the section does not define R-value requirements requirement #1 defines that the R-value installed needs to be in accordance with the compliance path that is used. Requirement #2 is specific to installation requirements for unfinished basement walls and requirement #3 is specific to installation requirements for finished basement walls. All requirements ensure that if the basement wall defines the building thermal envelope it is completely insulated and that there are no thermal bypasses allowed in the installation.

Cost Impact: The code change proposal will not increase or decrease the cost of construction
There is no cost impact associated with this code proposal as it only clarifies the existing installation requirements of the code that are not adequately defined in the current section of the code.

Proposal # 4796
RE55-19

IECC: R402.2.9 (IRC N1102.2.9)

Proponent: Darren Meyers, P.E., International Energy Conservation Consultants LLC, representing Self (dmeyers@ieccode.com)

2018 International Energy Conservation Code

Revise as follows:

R402.2.9 (IRC N1102.2.9) Basement walls. Walls associated with conditioned basements shall be insulated from the top of the basement wall down to 10 feet (3048 mm) below grade or to the basement floor, whichever is less. Walls associated with unconditioned basements shall comply with this requirement except where:

1. the floor overhead, including the underside stairway stringer leading to the basement, is insulated in accordance with Sections R402.1.2 and applicable provisions of R402.2, and R402.2.4.
2. there are no uninsulated duct, domestic hot water, or hydronic heating surfaces exposed to the basement, and
3. there are no HVAC supply or return diffusers serving the basement, and
4. the walls surrounding the stairway and adjacent to conditioned space are insulated in accordance with Sections R402.1.2 and applicable provisions of R402.2, and
5. the door(s) leading to the basement from conditioned spaces are insulated in accordance with Sections R402.1.2 and applicable provisions of R402.2, and weatherstripped in accordance with Section R402.4, and
6. the building thermal envelope separating the basement from adjacent conditioned spaces complies with Section R402.4.

Reason: It is outrightly false to presume that the simple act of insulating the floor over the basement absolves one from considering the basement an extension of "conditioned space." This proposal offers an outline of the appropriate characteristics that must be present in order to "willfully and knowingly" remove a basement from consideration as an extension of "conditioned space."

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

One has to presume that if the entirety of the country and affected territories were utilizing the provisions of Section R402.2.9 "as written," that the code change proposed would increase the cost of construction. Our belief is that a significant majority of the country enforcing the 2018 IECC has a level of sophistication consistent with the concepts of thermal and pressure boundaries proposed. As such, we believe, the code change proposal will not increase the cost of construction.

Proposal # 5460
RE56-19
IECC: R402.2.9 (IRC N1102.2.9)

Proponent: donald sivigny, State of MN, representing State of MN and Association of Minnesota Building Officials (don.sivigny@state.mn.us)

2018 International Energy Conservation Code
Revise as follows:

R402.2.9 (IRC N1102.2.9) Basement walls. Walls associated with conditioned basements shall be insulated from the top of the basement wall down to 10 feet (3048 mm) below grade or to the basement floor top of footing, whichever is less. Foundation insulation shall be installed in accordance with the manufacturer's instructions. Walls associated with unconditioned basements shall comply with this requirement except where the floor overhead is insulated in accordance with Sections R402.1.2 and R402.2.8.

Reason: The language in the IECC requirement is revised by replacing the phrase “or to the basement floor” with “or to the top of the footing.” The top of the footing is lower than the basement floor. This modification is necessary because the foundation system must be protected from heat loss beyond the top the basement floor system. By providing insulation to the top of the footing, heat loss at the intersection of the concrete floor and the foundation wall is reduced. This heat loss can create durability and moisture issues at the Foundation wall which will encourage mold growth. The section is further amended by adding a sentence that states, “Foundation insulation shall be installed according to the manufacturer’s installation instructions.” This additional requirement is necessary because if the manufacturer’s instructions are not followed, the product may not perform as it is intended.

Cost Impact: The code change proposal will not increase or decrease the cost of construction
The code (Section R303.2) currently requires products to be installed in accordance with the manufacturer’s instructions. The proposal simply reinforces the requirement to ensure that the insulation performs as intended. As such, no additional materials or installation labor are necessary.
**RE57-19**

**IECC: R402.4.1.1 (IRC N1102.4.1.1)**

**Proponent:** Aaron Gary, representing Self (aaron.gary@texenergy.org)

**2018 International Energy Conservation Code**

**Revise as follows:**

**R402.4.1.1 (IRC N1102.4.1.1) Installation.** The components of the building thermal envelope as indicated in Table R402.4.1.1 shall be installed in accordance with Grade I as defined by RESNET/ICC 301 Appendix A, the manufacturer's instructions and the criteria indicated in Table R402.4.1.1, as applicable to the method of construction. Where required by the code official, an approved third party shall inspect all components and verify compliance.

**Reason:** Unlike the ERI path, the Prescriptive and Performance path assume that envelope insulation is always installed as intended. Pointing only to the manufacturer's instructions however makes this very hard to manage for contractors and code officials as there is no central repository of manufacturer's instructions for them to easily reference nor do they usually have time to read more than what is clearly and simply stated in teh Code. Supplementing the manufacturer's installation instructions with something that is easy for all involved to reference and developed for ICC 700 (an ANSI approved standard that many of the insulation manufacturer's contributed to) would greatly increase the ease of use of the Code. Usable and understandable Code would lead to better installations and enforcement. The end result then would not be predicted savings (as models already assumes a near perfection which is rarely achieved in real life) but actual energy savings to the end user, i.e. the home owner or apartment dweller.

**Cost Impact:** The code change proposal will not increase or decrease the cost of construction

If the manufacturer's instructions are already being met, then this code proposal will not increase or decrease the cost of construction.

Proposal # 4560
### TABLE R402.4.1.1 (IRC N1102.4.1.1) 
**AIR BARRIER AND INSULATION INSTALLATION**

<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 or soffit shall be aligned with the insulation and any gaps in the air barrier shall be sealed. Access openings, drop down stairs or knee wall doorsto 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 framewalls shall be insulated by completely filling the cavity with a material having a thermal resistance, R-value, of not less than R-3 per inch. 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 framing and skylights, and the jambs of windows and doors, shall be sealed.</td>
<td>—</td>
</tr>
<tr>
<td>Rim joists</td>
<td>Rim joists shall include the air barrier.</td>
<td>Rim joists shall be insulated.</td>
</tr>
<tr>
<td>Floors, including cantilevered floors and floors above garages</td>
<td>The air barrier shall be installed at any exposed edge of insulation.</td>
<td>Floor framing cavity insulation shall be installed to maintain permanent contact with the underside of subfloor decking. Alternatively, floor framing cavity insulation shall be in contact with the top side of sheathing, or continuous insulation installed on the underside of floor framing; and shall extend from the bottom to the top of all perimeter floor framing members.</td>
</tr>
<tr>
<td>Crawl space walls</td>
<td>Exposed earth in unvented crawl spaces shall be covered with a Class I vapor retarder with overlapping joints taped.</td>
<td>Crawl space insulation, where provided instead of floor insulation, shall be permanently attached to the walls.</td>
</tr>
<tr>
<td>Shafts, penetrations</td>
<td>Duct shafts, utility penetrations, and flue shafts opening to exterior or unconditioned space shall be besealed.</td>
<td>—</td>
</tr>
<tr>
<td>Narrow cavities</td>
<td>—</td>
<td>Batts to be installed in narrow cavities shall be cut to fit or narrow cavities shall be filled with insulation that on installation readily conforms to the available cavity space.</td>
</tr>
<tr>
<td>Garage separation</td>
<td>Air sealing shall be provided between the garage and conditioned spaces.</td>
<td>—</td>
</tr>
<tr>
<td>Recessed lighting</td>
<td>Recessed light fixtures installed in the building thermal envelope shall be sealed to the finished surface.</td>
<td>Recessed light fixtures installed in the building thermal envelope shall be air tight and IC rated.</td>
</tr>
<tr>
<td>Plumbing and wiring</td>
<td>—</td>
<td>In exterior walls, batt insulation shall be cut neatly to fit around wiring and plumbing, or insulation, that on installation readily conforms to available space, shall extend behind piping and wiring.</td>
</tr>
<tr>
<td>Component</td>
<td>Requirement</td>
<td>Notes</td>
</tr>
<tr>
<td>----------------------------------</td>
<td>-------------------------------------------------------------------------------------------------</td>
<td>-------</td>
</tr>
<tr>
<td><strong>Shower/tub on exterior wall</strong></td>
<td>The air barrier installed at exterior walls adjacent to showers and tubs shall separate the wall from the shower or tub.</td>
<td></td>
</tr>
<tr>
<td><strong>Exterior walls adjacent to showers and tubs</strong> shall be insulated.</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Electrical/phone box on exterior walls</strong></td>
<td>The air barrier shall be installed behind electrical and communication boxes. Alternatively, air-sealed boxes shall be installed.</td>
<td></td>
</tr>
<tr>
<td><strong>HVAC register boots</strong></td>
<td>HVAC supply and return register boots that penetrate building thermal envelope shall be sealed to the subfloor, wall covering or ceiling penetrated by the boot.</td>
<td></td>
</tr>
<tr>
<td><strong>Concealed sprinklers</strong></td>
<td>Where required to be sealed, concealed fire sprinklers shall only be sealed in a manner that is recommended by the manufacturer. Caulking or other adhesive seals shall not be used to fill voids between fire sprinkler cover plates and walls or ceilings.</td>
<td></td>
</tr>
</tbody>
</table>

a. Inspection of log walls shall be in accordance with the provisions of ICC 400.

**Reason:** The redundancy in this requirement for continuous air barrier makes this section confusing. The thermal envelope is already the exterior wall so it doesn’t make sense to have that verbiage inserted here, so we are removing it along with the redundant statement.

**Cost Impact:** The code change proposal will not increase or decrease the cost of construction. We are just removing redundant language.

Proposal # 5318

RE58-19
2018 International Energy Conservation Code

Add new text as follows:

**R402.2.9 (IRC N1102.2.9) Basement Walls** Basement walls shall be insulated in accordance with Table R402.1.2.

**Exception:** Basement walls associated with unconditioned basements where the floor overhead is insulated in accordance with Sections R402.1.2 and R402.2.8.

Revise as follows:

**R402.2.9 (IRC N1102.2.9) R402.2.9.1 (IRC N1102.2.9.1) Basement walls insulation installation (Mandatory).** Walls associated with conditioned basements Where basement walls are insulated, the insulation shall be insulated installed from the top of the basement wall down to 10 feet (3048 mm) below grade or to the basement floor, whichever is less. Walls associated with unconditioned basements shall comply with this requirement except where the floor overhead is insulated in accordance with Sections R402.1.2 and R402.2.8.

**Reason:** R402.2.9 includes both prescriptive provisions (required insulation levels) and non-tradeable (mandatory) installation specifications. This proposal does not add new requirements; rather, it separates the prescriptive and mandatory provisions into separate sections.

The insulation installation requirements of new Sec. R402.2.9.1 have no value or metric that can be used for modeling purposes; they are non-tradeable (mandatory).

Note that the SEHPCAC has a proposal to eliminate the use of the labels “prescriptive” and “mandatory” in favor of a tabular method of identifying non-tradeable requirements. If that proposal is successful, ICC staff have stated that sections being individually approved to be labeled as ‘mandatory’ will instead have their respective section numbers added to the new C407.2 table of requirements that are non-tradeable in the performance path.

This proposal is submitted by the ICC Sustainable, Energy and High Performance Code Action Committee (SEHPCAC). The SEHPCAC was established by the ICC Board of Directors to pursue opportunities to improve and enhance International Codes with regard to sustainability, energy and high performance as it relates to the built environment included, but not limited to, how these criteria relate to the International Green Construction Code (IgCC) and the International Energy Conservation Code (IECC). In 2018-2019, the SEHPCAC has held five two- or three-day open meetings and numerous workgroup calls, to discuss and debate proposed changes and public comments. Attendees at the meetings and calls included members of the SEHPCAC as well as any interested parties. Related documentation and reports are posted on the SEHPCAC website at: http://www.iccsafe.org/cs/SEHPCAC/Pages/default.aspx

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

The code change may increase construction costs for a subset of buildings that may have been designed using the Total Building Performance or EIR compliance methods that did not follow the basement wall insulation installations provisions contained in this section.

Proposal # 4495
2018 International Energy Conservation Code

Revise as follows:

R402.2.10 (IRC N1102.2.10) Slab-on-grade floors. Slab-on-grade floors with a floor surface less than 12 inches (305 mm) below grade shall be insulated in accordance with Table R402.1.2. The insulation shall extend downward from the top of the slab on the outside or inside of the foundation wall. Insulation located below grade shall be extended the distance provided in Table R402.1.2 by any combination of vertical insulation, insulation extending under the slab or insulation extending out from the building. Insulation extending away from the building shall be protected by pavement or by not less than 10 inches (254 mm) of soil. The top edge of the insulation installed between the exterior wall and the edge of the interior slab shall be permitted to be cut at a 45-degree (0.79 rad) angle away from the exterior wall.

Exception: Slab-edge insulation is not required in jurisdictions designated by the code official as having a very heavy termite infestation.

Add new text as follows:

R402.2.10.1 (IRC N1102.2.10.1) Slab-on-grade floor insulation installation (Mandatory) Where installed, the insulation shall extend downward from the top of the slab on the outside or inside of the foundation wall. Insulation located below grade shall be extended the distance provided in Table R402.1.2 by any combination of vertical insulation, insulation extending under the slab or insulation extending out from the building. Insulation extending away from the building shall be protected by pavement or by not less than 10 inches (254 mm) of soil. The top edge of the insulation installed between the exterior wall and the edge of the interior slab shall be permitted to be cut at a 45-degree (0.79 rad) angle away from the exterior wall.

Reason: R402.2.10 includes both prescriptive provisions (insulation levels) and non-tradeable (mandatory) installation specifications, plus an embedded exception for termite infestations.

This proposal does not add new requirements; rather, it separates the prescriptive and mandatory provisions into separate sections and clarifies the exception to required insulation in jurisdictions designated by the code official as having a very heavy termite infestation.

The insulation installation requirements of new Sec. R402.2.10.1 have no value or metric that can be used for modeling purposes; they are non-tradeable (mandatory).

Note that the SEHPCAC has a proposal to eliminate the use of the labels "prescriptive" and "mandatory" in favor of a tabular method of identifying non-tradeable requirements. If that proposal is successful, ICC staff have stated that sections being individually approved to be labeled as 'mandatory' will instead have their respective section numbers added to the new C407.2 table of requirements that are non-tradeable in the performance path.

This proposal is submitted by the ICC Sustainable, Energy and High Performance Code Action Committee (SEHPCAC). The SEHPCAC was established by the ICC Board of Directors to pursue opportunities to improve and enhance International Codes with regard to sustainability, energy and high performance as it relates to the built environment included, but not limited to, how these criteria relate to the International Green Construction Code (IgCC) and the International Energy Conservation Code (IECC). In 2018-2019, the SEHPCAC has held five two- or three-day open meetings and numerous workgroup calls, to discuss and debate proposed changes and public comments. Attendees at the meetings and calls included members of the SEHPCAC as well as any interested parties. Related documentation and reports are posted on the SEHPCAC website at: http://www.iccsafe.org/cs/SEHPCAC/Pages/default.aspx

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

The code change may increase construction costs for a subset of buildings that may have been designed using the Total Building Performance or EIR compliance methods that included slab on grade with insulation installed not in accordance with the provisions of this section.
RE61-19

IECC: R402.2.11 (IRC N1102.2.11)

Proponent: Robby Schwarz, EnergyLogic, representing EnergyLogic (robbys@nrglogic.com)

2018 International Energy Conservation Code

Revise as follows:

R402.2.11 (IRC N1102.2.11) Crawl space walls. As an alternative to insulating floors over crawl spaces, crawl space walls shall be insulated provided that the crawl space is not vented to the outdoors. Crawl space wall insulation shall be permanently fastened to the wall and shall extend downward from the floor to the finished grade elevation and then vertically or horizontally for not less than an additional 24 inches (610 mm), sill plate on top of the crawlspace wall to the floor of the crawlspace. Exposed earth in unvented crawl space foundations shall be covered with a continuous Class I vapor retarder in accordance with the International Building Code or International Residential Code, as applicable. Joints of the vapor retarder shall overlap by 6 inches (153 mm) and be sealed or taped. The edges of the vapor retarder shall extend not less than 6 inches (153 mm) up stem walls and shall be attached and sealed to the stem walls.

Reason: The foundation of an unvented conditioned crawlspace must be insulated to have a continuous building thermal envelope. It is less clear if the floor of the crawlspace needs to be insulated. However, what is known is that the extension of the wall insulation 24” horizontally over the dirt or vapor retarder on the dirt floor inside the crawlspace is not being enforced with any regularity. When using the Ekotrope or REMRate modeling software to demonstrate compliance with the cost compliance report used in Section R405 it is easy to demonstrate no value associated with the 24" of extended insulation. The crawlspace dirt floor is 3-5 feet below grade and it is not required to be insulated fully. Similarly, there is no requirement to insulate the concrete floor in a basement that is eight feet below grade. If there were a requirement there would be countless arguments regarding the cost-effectiveness of the insulation. This proposal aims to take the 24” extension of insulation out of the code in order to fully focus on insulating the portion of the foundation that is associated with the majority of the heat loss or gain.

On the other side of the equation, when portions of concrete foundation walls are not insulated such as the top of the foundation adjacent to the sill plate it is easy to demonstrate value for the installation of insulation. IR camera imaging, as well as Ekotrope and REMRate modeling, can demonstrate the impact of small portions of uninsulated building thermal envelope.

Cost Impact: The code change proposal will not increase or decrease the cost of construction

Would be cost saving associated with this proposal as the 24” extension of insulation over the floor of the crawlspace would be removed as a requirement from the code while asking for a small portion of insulation to be installed at the top of the foundation wall.

Proposal # 4795

RE61-19
2018 International Energy Conservation Code

Add new text as follows:

R402.2.11 (IRC N1102.2.11) Crawl space walls. Crawl space walls shall be insulated in accordance with Table R402.1.2.

Exception: Crawlspace walls associated with a crawlspace that is vented to the outdoors and the floor overhead is insulated in accordance with Sections R402.1.2 and R402.2.8.

Revise as follows:

R402.2.11 (IRC N1102.2.11) R402.2.11.1 (IRC N1102.2.11.1) Crawl space walls, walls insulation installation (Mandatory). As an alternative to insulating floors over crawl spaces, crawl space walls shall be insulated provided that the crawl space is not vented to the outdoors. Crawl space wall insulation is installed, it shall be permanently fastened to the wall and shall extend downward from the floor to the finished grade elevation and then vertically or horizontally for not less than an additional 24 inches (610 mm). Exposed earth in unvented crawl space foundations shall be covered with a continuous Class I vapor retarder in accordance with the International Building Code or International Residential Code, as applicable. Joints of the vapor retarder shall overlap by 6 inches (153 mm) and be sealed or taped. The edges of the vapor retarder shall extend not less than 6 inches (153 mm) up stem walls and shall be attached to the stem walls.

Reason: Originally drafted as one section, the language included both prescriptive provisions (insulation levels) and mandatory insulation installation, and an embedded exception. This proposal does not add new requirements, it separates the prescriptive and mandatory provisions as well as the exception.

This proposal is submitted by the ICC Sustainable, Energy and High Performance Code Action Committee (SEHPCAC). The SEHPCAC was established by the ICC Board of Directors to pursue opportunities to improve and enhance International Codes with regard to sustainability, energy and high performance as it relates to the built environment included, but not limited to, how these criteria relate to the International Green Construction Code (IgCC) and the International Energy Conservation Code (IECC). In 2018-2019, the SEHPCAC has held five two- or three-day open meetings and numerous workgroup calls, to discuss and debate proposed changes and public comments. Attendees at the meetings and calls included members of the SEHPCAC as well as any interested parties. Related documentation and reports are posted on the SEHPCAC website at: http://www.iccsafe.org/cs/SEHPCAC/Pages/default.aspx

Cost Impact: The code change proposal will not increase or decrease the cost of construction

The code change may increase construction costs for a subset of buildings that may have been designed using the Total Building Performance or EIR compliance methods that included slab on grade with insulation installed not in accordance with the provisions of this section.

Proposal # 4698

RE62-19
Add new text as follows:

R402.2.14 (IRC N1102.2.14) Airspaces. Where the thermal properties of airspaces are used to comply with this code in accordance with Section R401.2, such airspaces shall be enclosed in an unventilated cavity constructed to minimize air-flow into and out of the enclosed air space. Airflow shall be deemed minimized when the enclosed airspace is located on the interior side of the continuous air-barrier and is bounded on all sides by building components.

**Exception:** The thermal resistance of airspaces located on the exterior side of the continuous air barrier and adjacent to and behind the exterior wall-covering material shall be determined in accordance with ASTM C1363 modified with an airflow entering the bottom and exiting the top of the airspace at an air movement rate of not less than 70 mm/second.

**Reason:** This proposal is identical to requirements for airspaces added to the 2018 IECC-C (Section 402.2.7). It also is consistent with ASHRAE 90.1-2016 (Section A9.4.2) which was the basis for IECC-C Section 402.2.7. These provisions will ensure that the R-value of airspaces are properly accounted for when used as an optional means of energy code compliance.

**Cost Impact:** The code change proposal will not increase or decrease the cost of construction. The proposal provides needed requirements for the additional and optional use of airspaces as a supplemental means of energy code compliance. This proposal may add an option that’s currently not in the code.
**RE64-19**

**IECC: R402.2.14 (IRC N1102.2.14) (New)**

**Proponent:** Jay Crandell, P.E., ARES Consulting / ABTG, representing Foam Sheathing Committee of the American Chemistry Council

**2018 International Energy Conservation Code**

Add new text as follows:

**R402.2.14 (IRC N1102.2.14) Airspaces** Where the R-value of an airspace is used for compliance in accordance with Section R401.2, the airspace shall be located on the interior side of the continuous air barrier and bounded on all sides by building components.

**Exception:** Alternative airspace conditions and means of determining R-value shall be permitted in accordance with Section C402.2.7.

**Reason:** This proposal coordinates the residential provisions with the prescriptive "deemed-to-comply" requirements for airspaces added to the 2018 IECC-C (Section 402.2.7). These requirements also are consistent with and based on ASHRAE 90.1-2016 (Section A9.4.2). They are applicable to both commercial and residential buildings because the thermal behavior of airspaces in assemblies doesn’t depend on building occupancy or use. Therefore, it is appropriate to consistently address airspace requirements in the IECC-R when their thermal resistance (R-value) is used as a means for compliance through the prescriptive, performance, or ERI approach of Section R401.2. An exception is provided to give flexibility for alternative airspace configurations or solutions based on the provisions (and exception) in Section C402.2.7 of the IECC-Commercial provisions.

For background on why these provisions were added to the 2018 IECC-C and also are needed in the IECC-R, the following explanation is provided. The R-values of airspaces are based on an assumption of "no air leakage" (see 2013 ASHRAE Handbook of Fundamentals, Chapter 26, Table 3, footnote b). This is illustrated in the figure below as an “ideal airspace”. As a practical matter, however, fully enclosed airspaces located to the interior of an air barrier are permitted to be considered ideal (see Case 1 in figure below). But, many airspace applications are far from “ideal” and are not fully enclosed; see Case 2 in the figure below. Air leakage into and out of an air-space due to ventilation airflow (especially if an intentionally vented airspace as common behind cladding systems) can significantly degrade its R-value, yet there is currently no standard calculation method or test method to account for this impact on an airspace R-value that otherwise is assumed to be “ideal”. This concern has been appropriately addressed in the IECC-C and, therefore, should be consistently applied to the IECC-R.

For additional information regarding performance of different air-space applications and conditions that affect R-value performance, refer to the figure below, a powerpoint at http://www.appliedbuildingtech.com/content/air-space-r-value, and the research report referenced in the bibliography.


**Cost Impact:** The code change proposal will not increase or decrease the cost of construction. The use of airspaces for compliance is not a requirement in the code and is therefore optional. This proposal provides for the option to appropriately include the R-value of airspaces which may reduce the cost of construction. For current applications that are using the R-value of airspaces that are not appropriately quantified or constructed, the cost of construction may increase. Thus, the appropriate conclusion is that the proposal may reduce cost, increase cost, or have no impact on cost depending on the specific case.
RE65-19

IECC: R202 (IRC N1101.6), R402.3 (IRC N1102.3) (New), ASTM Chapter 6 (IRC Chapter 44)

Proponent: Amanda Hickman, The Hickman Group, representing Reflective Insulation Manufacturers Association International (amanda@thehickmangroup.com)

2018 International Energy Conservation Code

SECTION R202 (IRC N1101.6)
GENERAL DEFINITIONS

Add new definition as follows:

RADIANT BARRIER. A material having a low emittance surface of 0.1 or less installed in building assemblies.

Add new text as follows:

R402.3 (IRC N1102.3) Radiant barriers (Mandatory). Where installed to reduce thermal radiation, radiant barriers shall be installed in accordance with ASTM C1743.

Add new standard(s) as follows:

ASTM

ASTM C1743: Standard Practice for Installation and Use of Radiant Barrier Systems (RBS) in Residential Building Construction

Reason: This proposal DOES NOT require the use of radiant barriers. But rather requires that WHEN radiant barriers are used, they comply with the appropriate ASTM standard. Furthermore this proposal provides important information to the code user and code enforcement community regarding radiant barriers.


The definition for "Radiant Barrier" was approved in the last cycle and is included in the 2015 IBC.

The proposed language is being included in this section specifically because the American Society for Testing and Materials (ASTM) classifies radiant barriers as thermal insulation. The ASTM committee C16 on Thermal Insulation includes published standards for this product. Subcommittee C16.21 deals specifically with reflective products, which include reflective insulation, radiant barrier and interior radiation control coatings. C16.21 develops standards and practices for these reflective building material thermal insulating products.

The Federal Trade Commission includes radiant barrier products in "CFR Part 460 Labeling and Advertising of Home Insulation: Trade Regulation Rule".

Radiant barrier products include a surface with an emittance of 0.1 or less that is installed in roof assemblies or attics with the low-emittance surface facing an open or ventilated air space. The low emittance material can be bonded to plastic film, woven fabric, reinforced paper, OSB or plywood. The thermal performance of radiant barriers depends on emittance and location in the attic, wall or roof assembly. Radiant barriers are predominantly installed in attic spaces below the roof deck. The low-emittance surface of radiant barrier products dramatically reduces the heat gain by radiation into the structure and attic HVAC ducts. For this reason, radiant barriers are especially effective in warm sunny climates where they provide reduced use of air conditioning. Radiant barrier products that are available include single-sheet material, multi-layer assemblies and wood sheathing with attached aluminum film or foil. The single sheet material is installed in roof assemblies by attaching directly to the roof deck, in between the rafters or trusses or to the underside of the rafters or trusses. The foil-faced sheathing is installed with the low-emittance side of the sheathing or panel facing toward the attic space to create a radiant barrier. Attic radiant barriers are in extensive use. These products have been on the market for several decades and are used by 87 of the top 100 US Builders. They have an established history and have been accepted into several regional code requirements. Over one billion square feet of the product is being installed annually.

Many state and jurisdictional codes already include references on radiant barriers. These are the state and city codes that include radiant barrier:

IBC: 2018 Section 1509 Radiant Barriers Installed Above Deck

Hawaii
Chapter 181 of Title 3, 2015, Section 407.2, Table 407.1

Texas

The Code of the City of Austin, Texas, Supplement 134-2018, Chapter 25-12, Article 12, Section R402.6

Florida


Section 405.7.1 Installation Criteria for homes claiming the radiant barrier option

Figure R405.7.1 Acceptable attic radiant barrier configurations

Table R303.2.1 Insulation Installation Standards

California

Title 24, 2016, Part 6, Subchapter 1, Definition Radiant Barrier

Title 24, 2016, Part 6, Subchapter 2, Section 110.8 Mandatory requirements for insulation, roofing products, and radiant barriers

Title 24, 2016, Part 6, Subchapter 8, Section 150.1 (c), Prescriptive standards / component packages

Title 24, 2016, Reference Residential Appendices, Radiant Barriers

Cost Impact: The code change proposal will not increase or decrease the cost of construction

This proposal will not increase the cost of construction because it only adds informational language regarding radiant barriers.
**Proponent:** Robby Schwarz, EnergyLogic, representing EnergyLogic (robby@nrglogic.com)

**2018 International Energy Conservation Code**
Revise as follows:

<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 or soffit shall be aligned with the insulation and any gaps in the air barrier shall be air sealed. Access openings, drop down stairs or knee wall doors to unconditioned attic spaces shall be air sealed in a manner that does not interfere with its accessibility.</td>
<td>The insulation in any dropped ceiling/soffit shall be aligned with the air barrier. All access hatches and doors shall be installed in accordance with Section R402.2.4. Raised vertical or diagonal surfaces that are greater than 1' foot in height into the ventilated attic shall be insulated in accordance with the knee wall provisions. Raised vertical or diagonal surfaces that are 1 foot or less in height into a ventilated attic shall be buried with insulation to maintain the ceilings R-value. Eave Baffles shall be installed in accordance with Section R402.2.3.</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. Cavities within corners and headers of framed walls shall be insulated by completely filling the cavity with a material having a thermal resistance, R-value, of not less than R-3 per inch. Exterior thermal envelope insulation for framed walls shall be installed in substantial contact and continuous alignment with the air barrier.</td>
<td>—</td>
</tr>
<tr>
<td>Windows, skylights, and doors</td>
<td>The space between framing and skylights, and the jambs of windows and doors, shall be sealed.</td>
<td>—</td>
</tr>
<tr>
<td>Rim joists</td>
<td>Rim joists shall include the air barrier.</td>
<td>Rim joists shall be insulated.</td>
</tr>
<tr>
<td>Floors, including cantilevered floors and floors above garages</td>
<td>The air barrier shall be installed at any exposed edge of insulation.</td>
<td>Floor framing cavity insulation shall be installed to maintain permanent contact with the underside of subfloor decking. Alternatively, floor framing cavity insulation shall be in contact with the top side of sheathing, or continuous insulation installed on the underside of floor framing; and shall extend from the bottom to the top of all perimeter floorframing members.</td>
</tr>
<tr>
<td>Crawl space walls</td>
<td>Exposed earth in unvented crawl spaces shall be covered with a Class I vapor retarder with overlapping joints taped.</td>
<td>Crawl space insulation, where provided instead of floor insulation, shall be permanently attached to the walls.</td>
</tr>
<tr>
<td>Shafts, penetrations</td>
<td>Duct shafts, utility penetrations, and flue shafts opening to exterior or unconditioned space shall be besealed.</td>
<td>—</td>
</tr>
<tr>
<td>Narrow cavities</td>
<td>—</td>
<td>Batts to be installed in narrow cavities shall be cut to fit or narrow cavities shall be filled with insulation that on installation readily conforms to the available cavity space.</td>
</tr>
<tr>
<td>Specification</td>
<td>Details</td>
<td>Details</td>
</tr>
<tr>
<td>-------------------------------</td>
<td>------------------------------------------------------------------------</td>
<td>------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Garage separation</td>
<td>Air sealing shall be provided between the garage and conditioned spaces</td>
<td></td>
</tr>
<tr>
<td>Recessed lighting</td>
<td>Recessed light fixtures installed in the building thermal envelope shall be sealed to the finished surface</td>
<td>Recessed light fixtures installed in the building thermal envelope shall be air tight and IC rated.</td>
</tr>
<tr>
<td>Plumbing and wiring</td>
<td>—</td>
<td>In exterior walls, batt insulation shall be cut neatly to fit around wiring and plumbing, or insulation, that on installation readily conforms to available space, shall extend behind piping and wiring.</td>
</tr>
<tr>
<td>Shower/tub on exterior wall</td>
<td>The air barrier installed at exterior walls adjacent to showers and tubs shall separate the wall from the shower or tub.</td>
<td>Exterior walls adjacent to showers and tubs shall be insulated.</td>
</tr>
<tr>
<td>Electrical/phone box on exterior walls</td>
<td>The air barrier shall be installed behind electrical and communication boxes. Alternatively, air-sealed boxes shall be installed.</td>
<td></td>
</tr>
<tr>
<td>HVAC register boots</td>
<td>HVAC supply and return register boots that penetrate building thermal envelope shall be sealed to the subfloor, wall covering or ceiling penetrated by the boot.</td>
<td></td>
</tr>
<tr>
<td>Concealed sprinklers</td>
<td>Where required to be sealed, concealed fire sprinklers shall only be sealed in a manner that is recommended by the manufacturer. Cauking or other adhesives or sealants shall not be used to fill voids between fire sprinkler cover plates and walls or ceilings.</td>
<td></td>
</tr>
</tbody>
</table>

a. Inspection of log walls shall be in accordance with the provisions of ICC 400.

Reason: Air barrier and air sealing criteria section:
- Air sealing measures are called out so the table column should incorporate air sealing in its name as it is different than air barrier.
- We are seeing attic access hatches caulked shut so the included language change is to ensure that access to the attic space is maintained.

Insulation installation criteria section:
- Section references have been incorporated in the proposed language change as code required installation issues have been defined in those sections of the code. The problem from an implementation perspective is that the defined installation is in the prescriptive section of the code. So, does the code intend for attic eave baffles to be traded off or not installed if a home uses R405 or R406 compliance paths? I don’t believe so. Therefore, the inclusion of section references ensures enforcement language and that the section becomes mandatory for all pathways in the code as it should be.
- Raised ceiling that penetrate into the attic space are particularly difficult to insulate. The guidance given by the proposed language helps those in the field identify particularly difficult areas to insulate, as well as, guidance on how to successful meet the code requirement.

Cost Impact: The code change proposal will not increase or decrease the cost of construction
The proposed language does not increase the cost of construction but rather offers guidance and clarity of existing requirements.

Proposal # 5347
### TABLE R402.4.1.1 (IRC N1102.4.1.1)  
**AIR BARRIER AND INSULATION INSTALLATION**

<table>
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</thead>
<tbody>
<tr>
<td><strong>General requirements</strong></td>
<td>A continuous air barrier shall be installed in the building envelope. The exterior thermal envelope contains a continuous air barrier. The building's thermal envelope shall contain a continuous air barrier that is in alignment with the insulation on the conditioned and unconditioned side of the assembly. All penetrations breaks or joints in the air barrier assembly shall be air sealed.</td>
<td>Air-permeable insulation shall not be used as an air sealing material. Air-permeable insulation shall be enclosed inside the air barrier assembly. Verification or certification of insulation installation shall be in accordance with Section R303.</td>
</tr>
<tr>
<td><strong>Ceiling/attic</strong></td>
<td>The air barrier in any dropped ceiling or soffit shall be aligned with the insulation and any gaps in the air barrier shall be sealed. Access openings, drop down stairs or knee wall doorways to unconditioned attic spaces shall be sealed. The insulation in any dropped ceiling/soffit shall be aligned with the air barrier.</td>
<td>—</td>
</tr>
<tr>
<td><strong>Walls</strong></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. Cavities within corners and headers of framed walls shall be insulated by completely filling the cavity with a material having a thermal resistance, R-value, of not less than R-3 per inch. Exterior thermal envelope insulation for framed walls shall be installed in substantial contact and continuous alignment with the air barrier.</td>
<td>—</td>
</tr>
<tr>
<td><strong>Windows, skylights and doors</strong></td>
<td>The space between framing and skylights, and the jambs of windows and doors, shall be sealed.</td>
<td>—</td>
</tr>
<tr>
<td><strong>Rim joists</strong></td>
<td>Rim joists shall include the air barrier. Rim joists shall be insulated.</td>
<td>—</td>
</tr>
<tr>
<td><strong>Floors, including cantilevered floors and floors above garages</strong></td>
<td>The air barrier shall be installed at any exposed edge of insulation. Floor framing cavity insulation shall be installed to maintain permanent contact with the underside of subfloor decking. Alternatively, floor framing cavity insulation shall be in contact with the top side of sheathing, or continuous insulation installed on the underside of floor framing; and shall extend from the bottom to the top of all perimeter floor framing members.</td>
<td>—</td>
</tr>
<tr>
<td><strong>Crawl space walls</strong></td>
<td>Exposed earth in unvented crawl spaces shall be covered with a Class I vapor retarder with overlapping joints taped. Crawl space insulation, where provided instead of floor insulation, shall be permanently attached to the walls.</td>
<td>—</td>
</tr>
<tr>
<td><strong>Shafts, penetrations</strong></td>
<td>Duct shafts, utility penetrations, and flue shaft openings to exterior or unconditioned space shall be besealed. Batts to be installed in narrow cavities shall be cut to fit or narrow cavities shall be filled with insulation that on installation readily conforms to the available cavity space.</td>
<td>—</td>
</tr>
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<td><strong>Narrow cavities</strong></td>
<td>—</td>
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<td><strong>Garage separation</strong></td>
<td>Air sealing shall be provided between the garage and conditioned spaces.</td>
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<td><strong>Recessed lighting</strong></td>
<td>Recessed light fixtures installed in the building thermal envelope shall be sealed to the finished surface. Recessed light fixtures installed in the building thermal envelope shall be air tight and IC rated.</td>
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</table>
In exterior walls, batt insulation shall be cut neatly to fit around wiring and plumbing, or insulation, that on installation readily conforms to available space, shall extend behind piping and wiring.

Shower/tub on exterior wall

The air barrier installed at exterior walls adjacent to showers and tubs shall separate the wall from the shower or tub. Exterior walls adjacent to showers and tubs shall be insulated.

Electrical/phone box on exterior walls

The air barrier shall be installed behind electrical and communication boxes. Alternatively, air-sealed boxes shall be installed.

HVAC register boots

HVAC supply and return register boots that penetrate building thermal envelope shall be sealed to the subfloor, wall covering or ceiling penetrated by the boot.

Concealed sprinklers

Where required to be sealed, concealed fire sprinklers shall only be sealed in a manner that is recommended by the manufacturer. Caulking or other adhesive sealants shall not be used to fill voids between fire sprinkler cover plates and walls or ceilings.

- Inspection of log walls shall be in accordance with the provisions of ICC 400.
- Air barrier and insulation full enclosure is not required in unconditioned/ventilated attic spaces and at rim joists.

Reason: Air barrier and air sealing criteria section:
- This code change proposal is intended to offer clarification to this section of table R402.4.1.1 for those in the field that use it to build homes that are compliant with the air testing requirements of the IECC. In the 2018 IECC definitions section, air barriers and building thermal envelope where changed to recognize that the air barrier and building thermal envelope are an assembly of things not necessarily one component of the building. See definitions below. By removing poor language regarding continuous air barriers this section has been focused to better define the alignment of the air barrier and thermal barrier. In addition, it offers definition for other requirements in the table for installing an interior air barrier in location like behind a tub.
  - **AIR BARRIER.** One or more materials joined together in a continuous manner to restrict or prevent the passage of air through the building thermal envelope and its assemblies.
  - **BUILDING THERMAL ENVELOPE.** The basement walls, exterior walls, floors, ceiling, roofs and any other building element assemblies that enclose conditioned space or provide a boundary between conditioned space and exempt or unconditioned space.
- Air sealing measures are called out so the table column should incorporate air sealing in its name as it is different than air barrier.

Insulation Installation Criteria:
- Manufacturers of air permeable insulation have begun to recognize that their installation literature must incorporate language and pictures showing that air permeable insulation must be enclosed inside of air barrier assemblies. This table promotes this installation instruction in location such as behind tubs, on attic knee walls, etc. Therefore, the general section should begin with an overarching statement that states how air permeable insulation shall be installed.
- See attached PDF insulation installation instructions from NAIMA

A footnote has been added to ensure a common understanding that insulation installed in a ventilated attic and at the rim joist is not required to be enclosed within an air barrier assembly. The new footnote is necessary as the item it is associated with defines the installed alignment between air barriers and air permeable insulation within building cavity installation, i.e. walls and floor cavities.

Using references to other sections of the code enables reinforcement of what is required. In this case, the reference is to certificates that document the R-values of the material installed which must be created and posted.

Cost Impact: The code change proposal will not increase or decrease the cost of construction

The proposed language does not increase the cost of construction but rather offers guidance and clarity of existing requirements.

Proposal # 5345
### 2018 International Energy Conservation Code

Revise as follows:

#### TABLE R402.4.1.1 (IRC N1102.1.1)

**AIR BARRIER AND INSULATION INSTALLATION**

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<td>The insulation in any dropped ceiling/soffit shall be aligned with the air barrier.</td>
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<tr>
<td><strong>Walls</strong></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 framed walls shall be insulated by completely filling the cavity with a material having a thermal resistance, R-value, of not less than R-3 per inch. Exterior thermal envelope insulation for framed walls shall be installed in substantial contact and continuous alignment with the air barrier.</td>
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<tr>
<td><strong>Windows, skylights and doors</strong></td>
<td>The space between framing and skylights, and the jambs of windows and doors, shall be sealed.</td>
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<td>Floor framing cavity insulation shall be installed to maintain permanent contact with the underside of subfloor decking. Alternatively, floor framing cavity insulation shall be in contact with the top side of sheathing, or continuous insulation installed on the underside of floor framing; and shall extend from the bottom to the top of all perimeter floor framing members.</td>
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<td>Recessed light fixtures installed in the building thermal envelope shall be sealed to the finished surface.</td>
<td>Recessed light fixtures installed in the building thermal envelope shall be air tight and IC rated.</td>
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<td>Plumbing and wiring, or other obstructions</td>
<td>All holes created by wiring, plumbing or other obstructions in the air barrier assembly shall be air sealed.</td>
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<td>In exterior walls, batt insulation shall be cut neatly to fit around wiring and plumbing, or insulation, that on installation readily conforms to available space shall extend behind piping and wiring.</td>
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<td>Insulation shall be installed to fill the available space and surround wiring, plumbing, or other obstructions, unless the required R-value can be met by installing insulation and air barrier systems completely to the exterior side of the obstructions.</td>
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<td>Shower/tub on exterior wall</td>
<td>The air barrier installed at exterior walls adjacent to showers and tubs shall separate the wall from the shower or tub.</td>
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**Reason**: Component:
- The component section of this table item has been amended to include other obstructions as there are a number of obstructions that end up in insulated building cavities that insulation must be split around so that it fully encloses the obstruction. In this revised section plumbing and wiring become examples of obstructions, but things like gas or HVAC duct works amongst other things now can be included.

**Air barrier and air sealing criteria section:**
- Although it seems obvious it does need to be stated that holes in the continuous air barrier need to be sealed. This is a specific reminder regarding holes that are created by wiring, plumbing, or other obstruction in cavities need to be air sealed.

**Insulation Installation Criteria:**
- Insulating around obstructions in building cavities can and may happen with material other than fiberglass batts. This code change proposal opens up the possibility of insulating plumbing in exterior walls, for example, so that the plumbing is not surrounded by insulation but rather completely exposed to the warm side of the cavity.

**Cost Impact**: The code change proposal will not increase or decrease the cost of construction
The proposed language does not increase the cost of construction, but rather offers guidance and clarity of existing requirements.

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Proposal #: 5396

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RE68-19
2018 International Energy Conservation Code

Revise as follows:

R402.4.1.1 (IRC N1102.4.1.1) Installation. The components of the building thermal envelope as indicated in Table R402.4.1.1 (1) shall be installed in accordance with the manufacturer’s instructions and the criteria indicated in Tables R402.4.1.1(1) and R402.4.1.1(2), as applicable to the method of construction. Where required by the code official, an approved third party shall inspect all components and verify compliance.

### TABLE R402.4.1.1(1) [IRC N1102.4.1.1 (1)]

#### AIR BARRIER AND INSULATION INSTALLATION

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a. Inspection of log walls shall be in accordance with the provisions of ICC 400.

Add new text as follows:

**TABLE R402.2.4.1.1(2) [IRC N1102.2.4.1.1(2)]**

**GRADE 1 INSULATION INSTALLATION**

*Grade 1 insulation installation requirements.*

- Inspection is conducted before insulation is covered.
- Air-permeable insulation is enclosed on all six sides and is in substantial contact with the sheathing material on one or more sides (interior or exterior) of the cavity. Air-permeable insulation in ceilings is not required to be enclosed when the insulation is installed in substantial contact with the surfaces it is intended to insulate.
- Cavity insulation uniformly fills each cavity side-to-side and top-to-bottom, without substantial gaps or voids around obstructions (such as blocking or bridging).
- Cavity insulation compression or incomplete fill amounts to 2 percent or less, presuming the compressed or incomplete areas are a minimum of 70 percent of the intended fill thickness; occasional small gaps are acceptable.
- Exterior rigid insulation has substantial contact with the structural framing members or sheathing materials and is tightly fitted at joints.
- Cavity insulation is split, installed, and/or fitted tightly around wiring and other services.
- Exterior sheathing is not visible from the interior through gaps in the cavity insulation.
- Faced batt insulation is permitted to have side-stapled tabs, provided the tabs are stapled neatly with no buckling, and provided the batt is compressed only at the edges of each cavity, to the depth of the tab itself.
- Where properly installed, ICFs, SIPs, and other wall systems that provide integral insulation are deemed in compliance with this section.

**Reason:** The table above is copied directly from ICC 700-2015. Unlike the ERI path, the Prescriptive and Performance path assume that envelope insulation is always installed as intended. Pointing only to the manufacturer's instructions however makes this very hard to manage for contractors and code officials as there is no central repository of manufacturer’s instructions for them to easily reference nor do they usually have time to read more than what is clearly and simply stated in the Code. Supplementing the manufacturer's installation instructions with something that is easy for all involved to reference and developed for ICC 700 (an ANSI approved standard that many of the insulation manufacturer's contributed to) would greatly increase the ease of use of the Code. Usable and understandable Code would lead to better installations and enforcement. The end result then would not be predicted savings (as models already assumes a near perfection which is rarely achieved in real life) but actual energy savings to the end user, i.e. the home owner or apartment dweller.

**Cost Impact:** The code change proposal will not increase or decrease the cost of construction. If the manufacturer's instructions are already being met, then this code change proposal will not increase or decrease the cost of construction.

Proposal # 4962
Revised version of TABLE R402.4.1.1 (IRC N1102.4.1.1) is as follows:

**2018 International Energy Conservation Code**

Revising as follows:

### TABLE R402.4.1.1 (IRC N1102.4.1.1)

**AIR BARRIER AND INSULATION INSTALLATION**

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<td>Recessed light fixtures installed in the building thermal envelope shall be air sealed to the finished surface in accordance with Section R402.4.5</td>
<td>Recessed light fixtures installed in the building thermal envelope shall be air tight, IC rated, and shall be buried or surrounded with insulation.</td>
</tr>
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a. Inspection of log walls shall be in accordance with the provisions of ICC 400.

**Reason:** Air barrier and air sealing criteria section:

- Recessed lighting fixture air leakage is outlined in the prescriptive section R402.4.5 and clearly describes that this component shall be air sealed. The instruction are not limited to sealing the recessed light to the finished surface, so referencing the requirements of the prescriptive section makes sense. In addition, there is need to ensure that the installation criteria is used when assessing R405 and R406 compliance. The addition of this language does that.

**Insulation Installation Criteria:**

- The concept of burring or surrounding building components in insulation was introduced last code development cycle. Metal housing of air tight canned lights are conductive and are now required to be manufactured so that insulation can be in continuous contact with them. At least R-30 attic insulation is required in all climate zones which means that the depth of the insulation is greater than the height of the recessed canned light. This additional language ensure that the insulation will be installed to fully cover the top of the cannot just be in contact with the side of the can.

**Cost Impact:** The code change proposal will not increase or decrease the cost of construction

The proposed language does not increase the cost of construction but rather offers guidance and clarity of existing requirements.

Proposal # 5395

RE70-19
## 2018 International Energy Conservation Code

Revise as follows:

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**Reason:** Insulation Installation Criteria:
- Many in the field that use table R402.4.1.1 use it as a guide to how to meet the requirements of the codes insulation and air leakage sections. Currently the component section for garage separation is blank on the insulation installation column. Unfortunately, many feel that because the section is blank that there is not a requirement to install insulation in the same manner as any other wall or floor component that separated conditioned and unconditioned space. Therefore, there is need to ensure that the installation criteria is used when assessing R402, R405 and R406 compliance. The addition of this language does that.

**Cost Impact:** The code change proposal will not increase or decrease the cost of construction
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2018 International Energy Conservation Code

Revising as follows:

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a. Inspection of log walls shall be in accordance with the provisions of ICC 400.

**Reason:** Air barrier and air sealing criteria section:
- Air sealing of these small cavities that connect to the exterior air barrier assembly need to be filled with something. Typically expanding air sealing foam would be used. This added language is in recognition that all narrow cavities cannot be practically insulated so instead they can be air sealed.

**Cost Impact:** The code change proposal will not increase or decrease the cost of construction
The proposed language does not increase the cost of construction but rather offers guidance and clarity of existing requirements.

Proposal # 5381
Proponent: Robby Schwarz, EnergyLogic, representing EnergyLogic (robby@nrglogic.com)

2018 International Energy Conservation Code
Revise as follows:

TABLE R402.4.1.1 (IRC N1102.4.1.1)
AIR BARRIER AND INSULATION INSTALLATION

Portions of table not shown remain unchanged.

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<tr>
<td>Shafts, penetrations</td>
<td>Duct shafts, utility penetrations, and flue shaft openings, and other similar penetrations to the exterior or unconditioned space shall be air sealed.</td>
<td>Penetrations through the building thermal envelope and what is passed through the penetration, shall not damage or compress the insulation surrounding the penetration.</td>
</tr>
</tbody>
</table>

a. Inspection of log walls shall be in accordance with the provisions of ICC 400.

Reason: Air barrier and air sealing criteria section:
- There are a number of penetrations that occur through the continuous air barrier assemblies of a home. They are too numerous to list yet some examples are given to create context and additional language was added to ensure that the examples were not thought to be the only penetrations that need to be sealed.

Insulation Installation Criteria:
- Insulating properly around a penetration and the object that is placed through the penetration in the building’s continuous air barrier assembly and thermal envelope is relatively easy to accomplish when insulation is installed after the penetration has been sealed, but when insulation has been installed first and then a penetration is created damaged insulation often occurs. In either instance this new language points out that insulation still must be installed well regardless.

See attached PDF for pictorial documentation

Cost Impact: The code change proposal will not increase or decrease the cost of construction
The proposed language does not increase the cost of construction but rather offers guidance and clarity of existing requirements.
TABLE R402.4.1.1 (IRC N1102.4.1.1)
AIRCARRIER, AIR SEALING, AND INSULATION INSTALLATION

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<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>
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<td>Ceiling/attic</td>
<td>The air barrier in any dropped ceiling or soffit shall be aligned with the insulation and any gaps in the air barrier shall be sealed. Access openings, drop down stairs or knee wall doors to unconditioned attic spaces shall be sealed.</td>
<td>The insulation in any dropped ceiling/soffit shall be aligned with the air barrier.</td>
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<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, R-value, of not less than R-3 per inch. Exterior thermal envelope insulation for framed walls shall be installed in substantial contact and continuous alignment with the air barrier.</td>
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<tr>
<td>Windows, skylights and doors</td>
<td>The space between framing and skylights, and the jambs of windows and doors, shall be sealed.</td>
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<td>Rim joists</td>
<td>Rim joists shall include the air barrier.</td>
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<td>Floors, including cantilevered floors and floors above garages</td>
<td>The air barrier shall be installed at any exposed edge of insulation.</td>
<td>Floor framing cavity insulation shall be installed to maintain permanent contact with the underside of floor decking. Alternatively, floor framing cavity insulation shall be in contact with the top side of sheathing, or continuous insulation installed on the underside of floor framing; and shall extend from the bottom to the top of all perimeter floor framing members.</td>
</tr>
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<td>Crawl space walls, basement walls, and slabs</td>
<td>Exposed earth in unvented crawl spaces shall be covered with a Class I vapor retarder/air barrier in accordance with Section R402.2.11, with overlapping joints taped. A Class 1 vapor retarder shall not be installed on the interior side of air permeable insulation in exterior below-grade walls. All penetrations through concrete foundation walls and slabs shall be air sealed.</td>
<td>Crawl space wall insulation installation, where provided instead of floor insulation, shall be permanently attached to the walls installed in accordance with Section R402.2.11. Conditioned basement foundation wall insulation shall be installed in accordance with Section R402.2.9. Slab on grade floor insulation shall be installed in accordance with Section R402.2.10.</td>
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<td>Batts to be installed in narrow cavities shall be cut to fit or narrow cavities shall be filled with insulation that on installation readily conforms to the available cavity space.</td>
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<td>Air sealing shall be provided between the garage and conditioned spaces.</td>
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<td>Recessed lighting</td>
<td>Recessed light fixtures installed in the building thermal envelope shall be sealed to the finished surface.</td>
<td>Recessed light fixtures installed in the building thermal envelope shall be air tight and IC rated.</td>
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<td>In exterior walls, batt insulation shall be cut neatly to fit around wiring and plumbing, or insulation, that installation readily conforms to available space, shall extend behind piping and wiring.</td>
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<td>The air barrier installed at exterior walls adjacent to showers and tubs shall separate the wall from the shower or tub.</td>
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<td>HVAC supply and return register boots that penetrate building thermal envelope shall be sealed to the subfloor, wall covering or ceiling penetrated by the boot.</td>
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<tr>
<td>Concealed sprinklers</td>
<td>Where required to be sealed, concealed fire sprinkler shall only be sealed in a manner that is recommended by the manufacturer. Caulking or other adhesives sealants shall not be used to fill voids between fire sprinkler cover plates and walls or ceilings.</td>
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a. Inspection of log walls shall be in accordance with the provisions of ICC 400.

**Reason:** Component:
- Currently only crawl space walls are being addressed by this table. Other foundation types such as basement and slabs have components that need to be addressed, thus the proposal to change the title of this component section.

**Air barrier and air sealing criteria section:**
- The vapor retarder criteria outlined in the prescriptive section R402.2.11 clearly describes how vapor retarders must be installed over the dirt floor of a conditioned crawl space. There is no need to further explain it in this table, but there is need to ensure that the installation criteria is used when assessing R405 and R406 compliance. The addition of this language does that.
- Barrowing from language used in the EnergyStar checklist, I have used this section to ensure that below grade walls are insulated, but do not contain a class 1 vapor retarder that can trap moisture behind them. More vapor permeable materials such as class 2 Kraft faced batts or perforated vinyl or FSK (foil scrim Kraft) blankets, as well as, class 3 vapor retarders are allowed. In Colorado we do see class 1 vapor retarders installed in this location and efficiency a building durability issue occur.
- Many feel that concrete foundation walls and slabs are air tight, but we forget that these building assemblies are often penetrated with sump pits, plumbing lines, and the like. These locations must be addressed in order to meet the air leakage requirements of the code.

**Insulation Installation Criteria:**
- Crawl space insulation installation as outlined in the prescriptive section R402.2.11 clearly describes how insulation must be installed on this component. There is no need to further explain it in this table, but there is need to ensure that the installation criteria is used when assessing R405 and R406 compliance. The addition of this language does that.
- Basement wall insulation installation is outlined in the prescriptive section R402.2.9 and clearly describes how insulation must be installed on this component. However, basement walls were never included as a component of this table. Therefore, there is need to ensure that the installation criteria is used when assessing R405 and R406 compliance. The addition of this language does that.
- Likewise slab insulation is outlined in the prescriptive section R402.2.10 and clearly describes how insulation must be installed on this component. However, slab insulation was never included as a component of this table. Therefore, there is need to ensure that the installation criteria is used when assessing R405 and R406 compliance. The addition of this language does that.

**Cost Impact:** The code change proposal will not increase or decrease the cost of construction

The proposed language does not increase the cost of construction but rather offers guidance and clarity of existing requirements.

Proposal # 5369
## TABLE R402.4.1.1 (IRC N1102.4.1.1)
### AIR BARRIER, AIR SEALING, AND INSULATION INSTALLATION

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<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>
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<td>Ceiling/attic</td>
<td>The air barrier in any dropped ceiling or soffit shall be aligned with the insulation and any gaps in the air barrier shall be sealed. Access openings, drop down stairs or knee wall doors to unconditioned attic spaces shall be sealed.</td>
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<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 framed walls shall be insulated by completely filling the cavity with a material having a thermal resistance, R-value, of not less than R-3 per inch. Exterior thermal envelope insulation for framed walls shall be installed in substantial contact and continuous alignment with the air barrier.</td>
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<td>Windows, skylights and doors</td>
<td>The space between framing and skylights, and the jambs of windows and doors, shall be sealed.</td>
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<td>Rim joists</td>
<td>Rim joists shall include the air barrier.</td>
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<td>Floors, separating conditioned from unconditioned space, including cantilevered floors and floors above garages</td>
<td>The air barrier shall be installed at any exposed edge of insulation. Floor cavity air permeable insulation shall be enclosed inside an air barrier assembly. Floor systems shall be fully air sealed including continuously air sealed at all edges and perimeter rim joist framing members.</td>
<td>Floor framing cavity insulation shall be installed to maintain permanent contact with the underside of subfloor decking. Alternatively, floor framing cavity insulation shall be in contact with the top edge of sheathing, or continuous insulation installed on the underside of floor framing, and shall extend from the bottom to the top of all perimeter floor framing members in accordance with the requirements of Section R402.2.8.</td>
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<tr>
<td>Crawl space walls</td>
<td>Exposed earth in unvented crawl spaces shall be recovered with a Class I vapor retarder with overlapping joints taped.</td>
<td>Crawl space insulation, where provided instead of floor insulation, shall be permanently attached to the walls.</td>
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<td>Duct shafts, utility penetrations, and flue shafts opening to exterior or unconditioned space shall be sealed.</td>
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a. Inspection of log walls shall be in accordance with the provisions of ICC 400.

**Reason:** Component:
- It needs to be clear that the floor cavities that are being addressed by this table are only floors that separate conditioned from unconditioned space. It is surprising how not all understand this.

**Air barrier and air sealing criteria section:**
- Floor cavities are wall cavities laid down, therefore, air permeable insulation installed inside the cavity also needs to be enclosed by the air barrier assembly. As the IECC allows alternative insulation techniques for insulating floors as seen in the exceptions detailed in Section R402.2.8 it become more important to ensure that the rim joist of the insulated floor not only get insulated, but is air tight, because the insulation no longer must be installed adjacent to the subfloor decking. The proposed language change brings this to light for builders and trades that are executing the code requirements.

**Insulation Installation Criteria:**
- The insulation installation criteria outlined in the prescriptive section R402.2.8 clearly describes how insulation in floor systems must be installed. There is no need to further explain it in this table, but there is need to ensure that the installation criteria is used when assessing R405 and R406 compliance. The addition of this language does that.

**Cost Impact:** The code change proposal will not increase or decrease the cost of construction
The proposed language does not increase the cost of construction but rather offers guidance and clarity of existing requirements.

Proposal # 5366

RE75-19
**2018 International Energy Conservation Code**

Revise as follows:

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**TABLE R402.4.1.1 (IRC N1102.4.1.1)**

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HVAC supply and return register boots that penetrate building thermal envelope shall be sealed to the subfloor, wall covering or ceiling penetrated by the boot.

Where required to be sealed, concealed fire sprinklers shall only be sealed in a manner that is recommended by the manufacturer. Caulking or other adhesives sealants shall not be used to fill voids between fire sprinkler cover plates and walls or ceilings.

Rooms containing a fuel burning appliance shall comply with Section R402.4.4.

Rooms containing a fuel burning appliance shall be insulated and air sealed in accordance with Section R402.4.4 and the requirements of this table.

a. Inspection of log walls shall be in accordance with the provisions of ICC 400.

Reason: Component Section:

- When added to the IECC, Rooms containing fuels burning appliances defined a new area of the building that defines the separation between conditioned space and unconditioned space (i.e. The Building Thermal Envelope). Therefore, the linkage between the requirements that are listed in the prescriptive section R402.4.4 and table R402.4.1.1 need to be consistently and thoroughly expressed in the code to better ensure compliance.

Air barrier and air sealing criteria section:

- Requirements for rooms containing fuel burning appliance is outlined in the prescriptive section R402.4.4 which clearly describes that this room defines the separation between conditioned space and unconditioned space and shall contain air barriers and be air sealed. However, this requirement is located in the prescriptive section of the code and therefore, there is need to ensure that the installation criteria is used when assessing R405 and R406 compliance. The addition of this language does that.

Insulation Installation Criteria:

- Requirements for rooms containing fuel burning appliance is outlined in the prescriptive section R402.4.4 which clearly describes that this room defines the separation between conditioned space and unconditioned space and shall insulated accordingly like any other assembly adjacent to the exterior of the home. However, this requirement is located in the prescriptive section of the code and therefore, there is need to ensure that the installation criteria is used when assessing R405 and R406 compliance. The addition of this language does that.

Cost Impact: The code change proposal will not increase or decrease the cost of construction. The proposed language does not increase the cost of construction, but rather offers guidance and clarity of existing requirements.
**2018 International Energy Conservation Code**

### TABLE R402.4.1.1 (IRC N1102.4.1.1)

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**Concealed sprinklers**
Where required to be sealed, concealed fire sprinklers shall only be sealed in a manner that is recommended by the manufacturer. Caulking or other adhesives/sealants shall not be used to fill voids between fire sprinkler cover plates and walls or ceilings.

| Area Separation Walls | Air sealing measures shall be permitted to be installed on top of approved fire blocking material installed within area separation walls when fire blocking remains visible after air sealing, to limit air infiltration and create an air barrier between conditioned and unconditioned space. Area separation/adiabatic walls shall be considered an exterior wall. | Insulation shall fully fill the stud cavity of area separation walls and be installed according to manufacture instructions. A 1” gap is allowed between the cavity insulation/framing and the area separation wall. |

- **Reason:**
  - Inspection of log walls shall be in accordance with the provisions of ICC 400.

- **Reason:** Component Section:
  - The 2009 IECC referenced air sealing common walls between dwelling units and this section of the IECC was removed during the 2012 code development cycle. The removal, however, did not diminish the significance of air leakage within these assemblies either directly from the outside or from unit to attached unit. It is EnergyLogic’s experience that town homes that are twice as small as a single family detached home leak twice as much, or more, than the single family home due solely to the area separation wall. Air sealing of this assembly cannot be ignored if our intent it to provide a code that offers a quantifiable amount of energy savings for all single-family dwelling units. This is why this section is being proposed to be added back into the code within this table.

- **Air barrier and air sealing criteria section:**
  - In Colorado we are finding success air sealing on top of approved fire blocking material. In this way the fire UL listed fire blocking material, which is usually installed in the same location where one wants to air seal, is not replaced by a non-UL listed material and the true area separation wall has not been disturbed. Take for example shaft liner area separation wall construction. The fire portion of the assembly is usually tow layers of 1” think type X gypsum which creates a two-hour fire separation. The type x gypsum is also an approved fire block that can be installed between the framing that holds the fire area separation wall in place and the two layers of type x gypsum fire area separation wall. The material is installed in the gap to the ventilated attic, between floors, and to the front and back of the dwelling units. When it is air sealed it is still visible and the air sealing does not impair it fire blocking ability.
  - The next proposed language in this section of the table states that area separation walls perform like any other exterior wall so if you have a component of this table that is installed adjacent to an area separation wall then it should be installed in accordance to the requirements and guidance of this table. For example, if a tub, drop ceiling, utility box, or knee wall is installed against an area separation wall then it should be installed in accordance with this table as it is outside of the fire rated portion of the assembly yet it ensures the continuity of the interior air barrier portion of the assembly.

- **Insulation Installation Criteria:**
  - The importance of installing insulation in accordance with manufacture instructions within area separation walls cannot be over stated. First, there is a significant amount of ambient air moving within the assemblies so it is a myth to believe that an adiabatic assembly has no heat loss or gain. Second the insulation is also used to dampen sound transmission from unit to unit. For these reasons the insulation installation verification must be equally as stringent as it is when observed in other assemblies. The language in this section specifically deals with the cavity insulation and recognizes that the assembly is often designed with a gap between the insulation and the fire rated portion of the assembly.

Go to the following web site to see


DOE Building America

"Air Sealing Best Practices and Code Compliance for Multifamily Area Separation Walls"

National Renewable Energy Laboratory Linh Truong

Pacific Northwest National Laboratory Pam Cole

IBACOS Ari Rapport

EnergyLogic Robby Schwarz
Additional Resource:


**Cost Impact:** The code change proposal will not increase or decrease the cost of construction
The proposed language does not increase the cost of construction, but rather offers guidance and clarity of existing requirements.
2018 International Energy Conservation Code
Revise as follows:

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HVAC register boots | HVAC supply and return register boots that penetrate building thermal envelope shall be sealed to the subfloor, wall covering or ceiling penetrated by the boot. | —

Concealed sprinklers | Where required to be sealed, concealed fire sprinklers shall only be sealed in a manner that is recommended by the manufacturer. Caulking or other adhesives/sealants shall not be used to fill voids between fire sprinkler cover plates and walls or ceilings. | Fire sprinklers installed in locations where they are subject to freezing shall be designed and installed in accordance with Section P2904 or NFPA 13D.

To maintain a contiguous air and thermal barrier it shall be permitted to bury the sprinkler piping in insulation to protect it from freezing.

To determine the minimum amount of insulation required above the sprinkler line when insulation is also installed below the line use the following formulas:

For cold regions: \( R_o = R_i \frac{(T_o - 40)}{40 - T_i} \)

For hot regions: \( R_o = R_i \frac{(T_o - 120)}{120 - T_i} \)

Where:

\( T_i = \) ACCA manual J Conditioned living space Indoor heating or cooling design temperature.

\( T_o = \) The lowest/highest recorded temperature of the outdoor, unconditioned attic space.

\( R_i = \) The R-value of the insulation used between the tubing and the conditioned living space below.

\( R_o = \) The R-value of the insulation used above the tubing.

a. Inspection of log walls shall be in accordance with the provisions of ICC 400.

**Reason:** Currently no insulation installation guidance is offered by table R402.1.1 from concealed sprinklers and the majority of the time sprinkler lines that are installed within the building’s thermal envelope or in ventilated unconditioned attics are installed in such a way that dramatically impacts the energy performance of the sections of envelope they are installed in. This is primarily due to installing insulation only on the cold side of the sprinkler line which creates a misalignment between the insulation and the air barrier. Installation techniques like tenting over the top of the sprinkler line or placing all the insulation to the cold side of the assembly are not part of the insulation manufactured installation instructions for any other obstruction in the assembly including water lines.

This proposed language and formula come from Uponor who manufactures a potable water fire sprinkler system that at times gets installed outside the conditioned space of the home. There is no sure way to ensure that the sprinkler line will not freeze regardless of how it is installed if the line is run in unconditioned space, but there are options out there to insulate the line and not damage the overall performance of the building’s thermal envelope. The proposal language merely points out the option without making any requirements that the insulation must be installed in a particular fashion. It mirrors the air barrier air sealing column of this section in that it does not attempt to supersede any fire code requirement.

Cost Impact: The code change proposal will not increase or decrease the cost of construction
The proposed language does not increase the cost of construction, but rather offers guidance and clarity of existing requirements.

Proposal # 5444
2018 International Energy Conservation Code
Revise as follows:

### TABLE R402.4.1.1 (IRC N1102.4.1.1)
AIR BARRIER AND INSULATION INSTALLATION

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HVAC supply and return register boots that penetrate building thermal envelope shall be air sealed to the subfloor, wall covering or ceiling penetrated by the boot.

**Concealed sprinklers**
Where required to be sealed, concealed fire sprinklers shall only be sealed in a manner that is recommended by the manufacturer. Caulking or other adhesives sealants shall not be used to fill voids between fire sprinkler cover plates and walls or ceilings.

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**Reason:** Air barrier and air sealing criteria section:
- The change to this section of language in the table slightly broadens the scope of sealing to not only include air sealing between inside and outside but to include sealing of all supply and return boots to the surface they penetrate. This helps to gain more control and predictability of air flow in and out of interstitial spaces as well as improves the performance of the HVAC system. This concept was first introduced by the Energy Star program.

**Insulation Installation Criteria:**
- Nationally we like open floor plans which means that more and more duct is being installed in exterior walls and attics. The supply and return duct installation and the insulation installation must be coordinated so that the insulation is not damaged or compressed resulting in the reduction of required R-value.

**Cost Impact:** The code change proposal will not increase or decrease the cost of construction
The proposed language does not increase the cost of construction, but rather offers guidance and clarity of existing requirements.

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Proposal # 5442

RE79-19
**RE80-19**

IECC: TABLE R402.4.1.1 (IRC N1102.4.1.1)

**Proponent:** Robby Schwarz, EnergyLogic, representing EnergyLogic (robby@nrglogic.com)

2018 International Energy Conservation Code

Revis is as follows:

**TABLE R402.4.1.1 (IRC N1102.4.1.1)**

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The air barrier shall be installed behind electrical and communication boxes. Alternatively, air-sealed boxes shall be installed.

Spaces behind electrical, phone, fan or other utility boxes on exterior walls shall be insulated or filled by insulation that on installation readily conforms to the available cavity space.

HVAC supply and return register boots that penetrate building thermal envelope shall be sealed to the subfloor, wall covering or ceiling penetrated by the boot.

Electrical, phone, fan or other utility boxes installed in floors, attics or to other insulated spaces shall have insulation cut or blown to fit snugly around them or upon installation readily conforms to the available space.

Where required to be sealed, concealed fire sprinklers shall only be sealed in a manner that is recommended by the manufacturer. Caulking or other adhesives/sealants shall not be used to fill voids between firesprinkler cover plates and walls or ceilings.

a. Inspection of log walls shall be in accordance with the provisions of ICC 400.

**Reason:** Component column:
- Although technically speaking, low voltage, speaker, or computer wire boxes are a form of electrical box many builders and trade partners only view true 20- or 15-amp power outlet or switch gang boxes as electrical boxes. By simply broadening the definition to utility box we can ensure that any such box that is installed in an exterior wall or ceiling is insulated and air sealed properly.

Air barrier and air sealing criteria section:
- In this section the two requirements have been broken apart for greater clarity. First an air tight box of some sort must be installed and second the box must be sealed to the surface that it penetrates.

Insulation Installation Criteria:
- Currently there is no guidance in this table regarding insulating behind electrical boxes in any insulated assembly. This added language rectifies this and offers guidance.

**Cost Impact:** The code change proposal will not increase or decrease the cost of construction
The proposed language does not increase the cost of construction, but rather offers guidance and clarity of existing requirements
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Shower/tub and fireplaces on exterior walls

- The air barrier installed at exterior walls adjacent to showers and tubs shall separate the wall from the shower or tub.
- An air barrier shall be installed to separate the exterior wall insulation from showers, tubs and fireplaces.
- Tub and shower drain trap penetrations through the subfloor shall be air sealed.
- Fireplace doors shall comply with the requirements of Section R402.4.2.

Exterior walls adjacent to showers, and tubs, and fireplaces shall separate the wall from the shower or tub be insulated and, where insulated with air permeable insulation, shall be enclosed by an air barrier assembly.

Electrical/phone box on exterior walls
- The air barrier shall be installed behind electrical and communication boxes. Alternatively, air-sealed boxes shall be installed.

HVAC register boots
- HVAC supply and return register boots that penetrate building thermal envelope shall be sealed to the subfloor, wall covering or ceiling penetrated by the boot.

Concealed sprinklers
- Where required to be sealed, concealed fire sprinklers shall only be sealed in a manner that is recommended by the manufacturer. Caulking or other adhesive sealants shall not be used to fill voids between fire sprinkler cover plates and walls or ceilings.

- Inspection of log walls shall be in accordance with the provisions of ICC 400.

**Reason:** Component column:
- The 2012 IECC Air barrier and Insulation table was the last table that specifically referenced the void space behind fireplaces that are located on exterior walls. Just like behind tubs and shower pans a supplemental air barrier is needed on the interior side to enclose the insulation as the drywall plain has been moved to the front of the fireplace.

**Air barrier and air sealing criteria section:**
- This first revision continues to require the installation of a supplemental air barrier in areas were drywall, tile backer, or other air impermeable material will not be installed as the finished surface is not in alignment with the insulation installed in the building’s thermal envelope. The only addition, other than clarification, is the addition of the area behind fireplaces on exterior walls.
- Air sealing the tub and shower drain trap penetration eliminates a significant leakage source especially when located in floor systems over unconditioned spaces. This air leakage often creates condensation on the back side of tubs and shower pans which leads to mold and other building durability issues.
- Fireplace door air sealing is outlined in the prescriptive section R402.4.2 and clearly describes that this component shall be air sealed. The instruction should not be limited to fireplaces that are installed using the prescriptive compliance options. Therefore, there is need to ensure that the installation criteria is used when assessing R405 and R406 compliance. The addition of this language does that.

**Insulation Installation Criteria:**
- Manufacturers of air permeable insulation have begun to recognize that their installation literature must incorporate language and pictures showing that air permeable insulation must be enclosed inside of air barrier assemblies. The current language offered no guidance of this fact and therefore was amended.
- See attached PDF example of newer installation instructions

**Cost Impact:** The code change proposal will not increase or decrease the cost of construction
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**2018 International Energy Conservation Code**

Revising as follows:

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<td>The space between framing and skylights, and the jambs of windows and doors, shall be sealed.</td>
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</tr>
<tr>
<td>Rim joists</td>
<td>Rim joists shall include an exterior air barrier. The junction of the rim board to the sill plate and the rim board and the subfloor shall be air sealed.</td>
<td>Rim joists shall be insulated so that the insulation maintains permanent contact with the exterior rim board.</td>
</tr>
<tr>
<td>Floors, including cantilevered floors and floors above garages</td>
<td>The air barrier shall be installed at any exposed edge of insulation.</td>
<td>Floor framing cavity insulation shall be installed to maintain permanent contact with the underside of subfloor decking. Alternatively, floor framing cavity insulation shall be in contact with the top side of sheathing, or continuous insulation installed on the underside of floor framing; and shall extend from the bottom to the top of all perimeter floor framing members.</td>
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<td>Crawl space walls</td>
<td>Exposed earth in unvented crawl spaces shall be covered with a Class I vapor retarder with overlapping joints taped.</td>
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<td>Duct shafts, utility penetrations, and flue shaft openings to exterior or unconditioned space shall be sealed.</td>
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<td>Batts to be installed in narrow cavities shall be cut to fit or narrow cavities shall be filled with insulation that on installation readily conforms to the available cavity space.</td>
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<td>In exterior walls, batt insulation shall be cut neatly to fit around wiring and plumbing, or insulation, that on installation readily conforms to available space, shall extend behind piping and wiring.</td>
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</tr>
</tbody>
</table>

a. Inspection of log walls shall be in accordance with the provisions of ICC 400.
b. Air barrier and insulation full enclosure is not required in unconditioned/ventilated attic spaces and at rim joists.

Reason: Table title change

- The objective of table R402.4.1.1 is to offer guidance for how to create an air tight home that meets the air leakage requirements of the IECC. Air barrier and insulation installation are part of the equation to be able to accomplish this goal, but air sealing is another part of it that is missing from the title. The tables name should accurately reflect what it is intended to do and that is what the proposal aim is. Currently air sealing measures are discussed to some extent in the table and the hope is that additional air sealing measure will be incorporated this cycle.

Air barrier and air sealing criteria section:

- In many sections of this table the guidance that is given tells the builder or trade partner to add a supplemental interior air barrier to the assembly. For example, at shafts, double walls, or behind tubs and fireplaces where the interior drywall, or primary interior air barrier is not in alignment with the insulation. The rim joist is one area where a nationally cost-effective solution for enclosing air permeable insulation with an interior air barrier has not been identified. Therefore, it is even more crucial that the exterior air barrier be air tight. The proposed language makes this clear.
- In order for the exterior air barrier to be air tight and air sealed properly the exterior rim board must be sealed to the sill plate and the sub floor. The added language ensure that this crucial area of low side air leakage is addressed.

Insulation installation criteria section:

- A footnote has been added to ensure a common understanding that insulation installed in a ventilated attic and at the rim is not require to be enclosed within an air barrier assembly. The footnote is necessary as the item it is associated with defines the installed alignment between air barriers and air permeable insulation within building cavity installation, i.e. walls and floor cavities.
- Most often fiberglass batt insulation is used to insulate the rim joist area of a home. If the batt is installed so that it is not in contact with the surface it is intended to insulated it does not work properly. We often see it installed in a crescent shape where the bulk of the material is not touching the rim board. The added language and footnote clearly and concisely describe how to insulate this unique area of a home.

See photo examples of the issues in the attached PDF

Cost Impact: The code change proposal will not increase or decrease the cost of construction
The proposed language does not increase the cost of construction but rather offers guidance and clarity of existing requirements.
RE83-19

IECC: TABLE R402.4.1.1

Proponent: Robby Schwarz, EnergyLogic, representing EnergyLogic (robby@nrglogic.com)

2018 International Energy Conservation Code

Revise as follows:

TABLE R402.4.1.1 (IRC TABLE N1102.4.1.1)

AIR BARRIER, AIR SEALING, AND INSULATION INSTALLATION

Portions of table not shown remain unchanged.

<table>
<thead>
<tr>
<th>COMPONENT</th>
<th>AIR BARRIER CRITERIA</th>
<th>INSULATION INSTALLATION CRITERIA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Windows, skylights and doors</td>
<td>The space between framing and skylights, and the jambs of windows and doors, shall be air sealed.</td>
<td>Insulation installed in framing around windows, skylights and doors shall be cut to fit the cavity or shall be filled with insulation that on installation readily conforms to the available cavity space.</td>
</tr>
</tbody>
</table>

a. Inspection of log walls shall be in accordance with the provisions of ICC 400.

Reason: Air barrier and air sealing criteria section:
- A simple adjective creates better clarity

Insulation installation criteria section:
- Often the framing around windows creates spaces that are odd sizes and shapes. I think of a recent house that I inspected that had several octangle widows fit into a square opening. The cavities that were created would not be defined as narrow cavities section of this table, but would be addressed be the proposed language.

See attached PDF for pictorial documentation of the issue

Cost Impact: The code change proposal will not increase or decrease the cost of construction
The proposed language does not increase the cost of construction but rather offers guidance and clarity of existing requirements.
## 2018 International Energy Conservation Code

Revise as follows:

### TABLE R402.4.1.1 (IRC N1102.4.1.1)

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</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 or soffit shall be aligned with the insulation and any gaps in the air barrier shall be sealed. Access openings, drop down stairs or knee wall doors to unconditioned attic spaces shall be sealed.</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 air sealed.</td>
<td>Wall and knee wall cavity air permeable insulation shall be enclosed inside the air barrier assembly.</td>
</tr>
<tr>
<td></td>
<td>The junction of the all top plates and drywall adjacent to unconditioned space above shall be gasketed or air sealed.</td>
<td>Corners in exterior frame walls shall be insulated by completely filling the cavity with a material having a thermal resistance, R-value, of not less than R-3 per inch.</td>
</tr>
<tr>
<td></td>
<td>Knee walls shall be air sealed.</td>
<td>Headers on exterior walls shall be insulated to a minimum R-3.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Building thermal envelope insulation for framed walls shall be installed in substantial contact and continuous alignment with the air barrier assembly.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Knee wall cavities that are defined by roof truss framing shall maintain a minimum 3.5&quot; inch insulated cavity that can accommodate an R-value that is either required in the wall or can be traded off.</td>
</tr>
<tr>
<td>Windows, skylights and doors</td>
<td>The space between framing and skylights, and the jambs of windows and doors, shall be sealed.</td>
<td>—</td>
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<tr>
<td>Rim joists</td>
<td>Rim joists shall include the air barrier.</td>
<td>Rim joists shall be insulated.</td>
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<td>Floors, including cantilevered floors and floors above garages</td>
<td>The air barrier shall be installed at any exposed edge of insulation.</td>
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<td>Exposed earth in unvented crawl spaces shall be covered with a Class I vapor retarder with overlapping joints taped.</td>
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<td>Batts to be installed in narrow cavities shall be cut to fit or narrow cavities shall be filled with insulation that on installation readily conforms to the available cavity space.</td>
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<td>Garage separation</td>
<td>Air sealing shall be provided between the garage and conditioned spaces.</td>
<td>—</td>
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</tbody>
</table>
### Recessed Lighting

Recessed light fixtures installed in the building thermal envelope shall be sealed to the finished surface.

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<tr>
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<td>Recessed light fixtures installed in the building thermal envelope shall be sealed to the finished surface.</td>
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</table>

### Plumbing and Wiring

In exterior walls, batt insulation shall be cut neatly to fit around wiring and plumbing, or insulation, that is installed readily conforms to available space, shall extend behind piping and wiring.

<table>
<thead>
<tr>
<th>Plumbing and wiring</th>
</tr>
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<tbody>
<tr>
<td>In exterior walls, batt insulation shall be cut neatly to fit around wiring and plumbing, or insulation, that is installed readily conforms to available space, shall extend behind piping and wiring.</td>
</tr>
</tbody>
</table>

### Shower/Tub on Exterior Wall

The air barrier installed at exterior walls adjacent to showers and tubs shall separate the wall from the shower or tub.

<table>
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<tr>
<th>Shower/tub on exterior wall</th>
</tr>
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<td>The air barrier installed at exterior walls adjacent to showers and tubs shall separate the wall from the shower or tub.</td>
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</tbody>
</table>

### Electrical/Phone Box on Exterior Walls

The air barrier shall be installed behind electrical and communication boxes. Alternatively, air-sealed boxes shall be installed.

<table>
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<tr>
<th>Electrical/Phone box on exterior walls</th>
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</table>

### HVAC Register Boots

HVAC supply and return register boots that penetrate building thermal envelope shall be sealed to the subfloor, wall covering or ceiling penetrated by the boot.

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<td>HVAC supply and return register boots that penetrate building thermal envelope shall be sealed to the subfloor, wall covering or ceiling penetrated by the boot.</td>
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### Concealed Sprinklers

Where required to be sealed, concealed fire sprinklers shall only be sealed in a manner that is recommended by the manufacturer. Caulking or other adhesive sealants shall not be used to fill voids between fire sprinkler cover plates and walls or ceilings.

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a. Inspection of log walls shall be in accordance with the provisions of ICC 400.

### Reason: Table title change

- The objective of table R402.4.1.1 is to offer guidance for how to create an air tight home that meets the air leakage requirements of the IECC. Air barrier and insulation installation are part of the equation to be able to accomplish this goal, but air sealing is another part of it that is missing from the title. The tables name should accurately reflect what it is intended to do and that is what the proposal aim is. Currently air sealing measures are discussed to some extent in the table and the hope is that additional air sealing measure will be incorporated this cycle.

### Air barrier and air sealing criteria section:

- Clarification of the language requiring drywall to be sealed to the top plate is needed. In the field there is confusion regarding what exterior means. Does it mean four exterior walls or does it mean top plates that are adjacent to unconditioned space. The gained clarity of this air sealing activity addresses one of the largest air leakage sources on the high side of the home.
- The junction of the bottom plate to the subfloor on exterior walls had not been addressed yet is again one of the largest sources of air leakage in homes and therefore was added to the table.

### Insulation Installation Criteria:

- Air permeable insulation must be enclosed in an air barrier in order to trap the pockets of air that are required to resist the flow of energy. This new language expresses that so it can be executed properly in the field.
- Corners and headers are significantly different assemblies. Headers, in particulate may not have a true cavity to insulate and may be better suited to insulate with foam board. This proposal breaks the two assemblies into separately addressed assemblies.
- Adding the defined term Building Thermal Envelope ensures clarity in this section of the code.
- Nationally we are seeing more and more knee walls that are defined by the flat edge of a 2x4 truss. The 1.5” dimension does not offer enough space to properly insulate. In such cases the truss will need to be over framed to enable insulation to be installed. The included language defines the minimum insulated space.

### Cost Impact:

The code change proposal will not increase or decrease the cost of construction. The proposed language does not increase the cost of construction but rather offers guidance and clarity of existing requirements.
2018 International Energy Conservation Code
Revise as follows:

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<td>Cavities within corners and headers of framed walls shall be insulated by completely filling the cavity with a material having a thermal resistance, R-value, of not less than R-3 per inch. Exterior thermal envelope insulation for framed walls shall be installed in substantial contact and continuous alignment with the air barrier.</td>
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The air barrier shall be installed behind electrical and communication boxes. Alternatively, air-sealed boxes shall be installed.

HVAC supply and return register boots that penetrate building thermal envelope shall be sealed to the subfloor, wall covering or ceiling penetrated by the boot.

Where required to be sealed, concealed fire sprinklers shall only be sealed in a manner that is recommended by the manufacturer. Caulking or other adhesives/sealants shall not be used to fill voids between fire sprinkler cover plates and walls or ceilings.

- a. Inspection of log walls shall be in accordance with the provisions of ICC 400.
- b. The requirements of this table are mandatory in accordance with Section R402.4 and shall be applied to all components of the building’s thermal envelope. Building elements not specifically addressed in the table shall be sealed, as appropriate, and consistent with the requirements of this table in order to maintain the continuity of the air barrier.

**Reason:** The objective of table R402.4.1.1 is to offer guidance for how to create an air tight home that meets the air leakage requirements of the IECC. Air barrier and insulation installation are part of the equation to be able to accomplish this goal, but air sealing is another part of it that is missing from the title. The tables name should accurately reflect what it is intended to do and that is what the proposal aim is.

An additional footnote is being proposed here to first reiterate that the items included in this table are mandatory and second to show that in reality the principals demonstrated in the table are the important mandatory items. The code, and this table in particular cannot address every situation that will arise in the field. Therefore, the principals of installation air barrier, air sealing, and insulation installation demonstrated in the table must be clearly expressed and exemplified in order for builders and trade partners to successfully executed them regardless as unique instances of construction and installation occur.

For example, the table reinforces the need for the continuity of the air barrier assembly and its alignment with the thermal barrier of the home. The components described in the table express many of the situations where this must be executed but it can’t explain every unique knee wall, tub, or fire fireplace surround. Therefore, the principals embodies in the table are used to successfully execute the continuity of the air barrier and alignment with insulation throughout the building thermal envelope.

**Cost Impact:** The code change proposal will not increase or decrease the cost of construction.

The proposed language does not increase the cost of construction but rather offers guidance and clarity of existing requirements.
Proponent: Howard Ahern, representing self (howard.ahern@airexmf.com)

2018 International Energy Conservation Code
Revise as follows:

### TABLE R402.4.1.1 (IRC N1102.4.1.1)
**AIR BARRIER AND INSULATION INSTALLATION**

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<td>Shafts, penetrations</td>
<td>Duct shafts, utility penetrations and flue shafts opening to exterior or unconditioned space shall be sealed. Utility penetrations of the air barrier shall be caulked, gasketed or otherwise sealed and shall allow for expansion, contraction of materials and mechanical vibration.</td>
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<td>Reason</td>
</tr>
<tr>
<td>-------------------------------</td>
<td>---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
<td>-----------------------------------------------------------------------------------------------</td>
</tr>
</tbody>
</table>
| Shower/tub on exterior wall   | The air barrier installed at exterior walls adjacent to showers and tubs shall separate the wall from the shower or tub.                                                                           | **Reason:** This change gives clarification to utility penetrations sealing of the air barrier and provide for more sustainable sealing and is the same language adopted in the 2018 IECC C402.5.1.1-  
"Penetrations of the air barrier shall be caulked, gasketed or otherwise sealed in a manner compatible with the construction materials and location. Sealing shall allow for expansion and contraction of materials and mechanical vibration."  
Sealing need to allow for expansion and contraction of materials so they do not crack, or dislodge form the material they are affixed too. Utility penetrations can be plumbing piping, gas piping but refrigerant piping vibrates and must be sealed in a manner to allow this mechanical vibration.  
**Cost Impact:** The code change proposal will not increase or decrease the cost of construction  
This change will not increase the cost of construction, the change simply tells the installer that sealing methods must allow for expansion and contraction and in the case of refrigeration piping that unlike other pipe penetration it vibrate so some sealing items might not cope with vibration or turn to power from the friction created. |
| Electrical/phone box on exterior walls | The air barrier shall be installed behind electrical and communication boxes. Alternatively, air-sealed boxes shall be installed.                                                                 |                                                                                               |
| HVAC register boots           | HVAC supply and return register boots that penetrate building thermal envelope shall be sealed to the subfloor, wall covering or ceiling penetrated by the boot.                                              |                                                                                               |
| Concealed sprinklers          | Where required to be sealed, concealed fire sprinklers shall only be sealed in a manner that is recommended by the manufacturer. Caulking or other adhesive sealants shall not be used to fill voids between fire sprinkler cover plates and walls or ceilings. |                                                                                               |

a. Inspection of log walls shall be in accordance with the provisions of ICC 400.

Proposal # 5241
**RE87-19**

**IECC: TABLE R402.4.1.1 (IRC N1102.4.1.1)**

**Proponent:** Kevin Rose, representing Mass Save

**2018 International Energy Conservation Code**

Revise as follows:

**AIR BARRIER AND INSULATION INSTALLATION**

Portions of table not shown remain unchanged.

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<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</td>
<td>All insulation shall be installed at Grade I quality in accordance with RESNET/ICC 301.</td>
</tr>
<tr>
<td></td>
<td>thermal envelope contains a continuous air barrier. Breaks or joints in the air</td>
<td>Air-permeable insulation shall not be used as a sealing material.</td>
</tr>
<tr>
<td></td>
<td>barrier shall be sealed.</td>
<td></td>
</tr>
</tbody>
</table>

**Reason:** Currently, the code requires that insulation is installed “in accordance with the manufacturer’s instructions.” As these instructions vary by product and manufacturer, the code requirement for insulation installation quality does not seem to be applied consistently across the industry and is difficult to enforce. The intent of this code change is establish a single, clear, consistent standard for high quality insulation installation by leveraging ICC/RESNET 301, a consensus standard already referenced by the 2018 IECC.

The intent of the current language is not being realized in the field. A 2016 study of 146 new homes in Massachusetts shows that, despite a long history of utility efficiency programs and progressive energy codes, insulation installation in the state has significant room for improvement. Table 14 of this study provides the full breakdown of insulation installation quality data in these 146 homes; the primary finding is that the vast majority of homes in the state receive merely fair installation quality.

“Auditors estimated that 86% of homes have mostly Grade II, a typical installation quality represented by moderate amounts of gaps and compression. Grade I—the best quality, representing an install with limited installation defects—is the majority install quality in only 10% of the homes.” (pg. 17).


**Cost Impact:** The code change proposal will not increase or decrease the cost of construction. This proposal only provides clearer and more enforceable language than the existing code. It does not alter the intended stringency of the code provision, and it does not incur any additional installation or verification costs. Therefore there is no change in the cost of construction.
2018 International Energy Conservation Code

SECTION R202 (IRC N1101.6)
GENERAL DEFINITIONS

Add new definition as follows:

**DWELLING UNIT ENCLOSURE AREA.** The sum of the area of ceiling, floors, and walls separating a dwelling unit’s conditioned space from the exterior or from adjacent conditioned or unconditioned spaces. Wall height shall be measured from the finished floor of the dwelling unit to the underside of the floor above.

R402.4 (IRC N1102.4) Air leakage (Mandatory). The building thermal envelope shall be constructed to limit air leakage in accordance with the requirements of Sections R402.4.1 through R402.4.5.

Revise as follows:

R402.4.1.2 (IRC N1102.4.1.2) Testing. The building or dwelling unit shall be tested and verified as having an air leakage rate not exceeding five air changes per hour in Climate Zones 1 and 2, and three air changes per hour in Climate Zones 3 through 8. Testing shall be conducted in accordance with RESNET/ICC 380, ASTM E 779 or ASTM E 1827 and reported at a pressure of 0.2 inch w.g. (50 Pascals). Where required by the code official, testing shall be conducted by an approved third party. A written report of the results of the test shall be signed by the party conducting the test and provided to the code official. Testing shall be performed at any time after creation of all penetrations of the building thermal envelope.

During testing:

1. Exterior windows and doors, fireplace and stove doors shall be closed, but not sealed, beyond the intended weatherstripping or other infiltration control measures.
2. Dampers including exhaust, intake, makeup air, backdraft and flue dampers shall be closed, but not sealed beyond intended infiltration control measures.
3. Interior doors, where installed at the time of the test, shall be open.
4. Exterior or interior terminations for continuous ventilation systems shall be sealed.
5. Heating and cooling systems, where installed at the time of the test, shall be turned off.
6. Supply and return registers, where installed at the time of the test, shall be fully open.

**Exception:** An air leakage rate not exceeding 0.30 cfm per ft² of the dwelling unit enclosure area shall be an accepted alternative in all climate zones for:

1. Attached single and multifamily building dwelling units.
2. Buildings or dwelling units that are 1500 square feet or smaller.

R403.6 (IRC N1103.6) Mechanical ventilation (Mandatory). The building and each dwelling unit shall be provided with ventilation that complies with mechanical ventilation. The mechanical ventilation system shall comply with the requirements of the International Residential Code or International Mechanical Code, as applicable, or with other approved means of ventilation. Outdoor air intakes and exhausts shall have automatic or gravity dampers that close when the ventilation system is not operating.

**Reason:** Air changes per hour (ACH) is a volumetric calculation that is used to express air exchanges in a home when the house is brought to 50 Pascal's pressure with relation to outside. It is calculated using the house volume and the cubic feet per minute airflow rate as measured at the blower door to reflect the number of times each hour the volume of air in the house is exchanged with the outside. Although it can be used to express the air leakage rate of an efficient or inefficient home, it does not have a direct correlation with the holes through which air is passing and, therefore, is not a measurement that is best used to quantify how air tight a dwelling is. This is especially true for small volume and attached dwellings.

This proposal introduces an exception to using ACH to quantify air leakage in attached and small volume dwelling units because ACH is biased against small volume and attached dwellings. Although it is not difficult to get a single-family median size home to pass 3 or 5 ACH as required by the IECC, it is significantly difficult to get a small volume and or an attached home to pass. The alternative metric more accurately reflects leakage through the exterior enclosure area which removes built in volumetric bias while continuing to ensure a tight structure.

The alternative metric uses a cubic foot per minute (CFM) per square foot (ft²) of dwelling unit enclosure area metric to demonstrate compliance with the IECC. This metric allows the air leakage measured at 50 Pascals divided by the building surface area to be used to assess the air tightness of
the building enclosure. Unlike ACH, a CFM/ft² of dwelling unit enclosure area normalizes the building air leakage per unit of building envelope surface area, the actual location where air is infiltrating or exfiltrating the dwelling regardless of where the air is coming from, which removes the volumetric bias that is causing small volume and attached dwellings units to fail the code require blower door test. In addition, it is not possible to only measure air leakage to the ambient outdoors in attached dwellings which is what ACH assumes. The air leakage measurement is actually quantifying the leakage that is coming from attached dwellings, stairs, elevator shafts or other parts of the building that may be connected to the living space of the tested unit. Air leakage from a conditioned space to any other space, as well as, two the ambient outdoors continues to be an energy efficiency issue, but it also is a health issue from an indoor air quality perspective, as well as, a building durability issue from a building science perspective. Reducing air leakage from all surfaces of the building enclosure promotes the IECC’s intent while providing a metric that makes better sense for the building type in question.

The use of a more accurate reflection of air leakage that better represents the distribution of holes that are occurring in the building enclosure has begun to be adopted in programs such as EnergyStar, LEED, and Passive House and by standards created by the US Army Corp of Engineers and ASHRAE. Largely this is happening in multifamily construction as looking at the CFM/ft² of building enclosure area better represents leakage that is occurring in an attached dwelling unit. However, small volume is also a significant issue which this proposal addresses. The CFM/ft² of enclosure area will allow both small volume and attached dwellings to be more successful at meeting the intent and requirements of the code.

The proposal also defines “Dwelling Unit Enclosure Area” as the sum of the area of ceiling, floors, and walls separating a dwelling unit’s conditioned space from the exterior or from adjacent conditioned or unconditioned spaces. In addition, the definition offers a small piece of defined guidance in order to further understand the measurement that must take place to calculate the dwelling unit enclosure area. This guidance states that the wall height shall be measured from the finished floor of the dwelling unit to the underside of the floor above. Lastly, the proposal ensures that the intent of the code, to ensure that the structure is built tight and ventilated correctly with mechanical ventilation, is maintained. If this exception is adopted into the code, as proposed, then ventilation must also be ensured regardless of how air tightness of the structure is expressed.

Why the change to R403.6?

It was pointed out in the last code cycle, that this metric could have an unintended loophole since it is not used in the IRC. To avoid that, the section was edited to to ensure whole house mechanical ventilation continues to be required and installed

Why The change to IRC 303.4?

It was pointed out in the last code cycle, that this metric could have an unintended loophole since it is not used in the IRC. To avoid that, the section was edited to ensure whole house mechanical ventilation continues to be required and installed

Cost Impact: The code change proposal will decrease the cost of construction

This proposal would reduce cost for the following reasons.

- Some jurisdictions nationally allow Guarded testing, an alternative blower door testing method that attempts to only quantify air leakage between conditioned space and the outdoors. This testing method requires multiple individuals and blower doors to be run simultaneously. Using a CFM/ft² of enclosure area Metric ensures a tight building thermal enclosure in the most cost-effective way by only requiring one tester and piece of equipment per test.

- Air leakage pathways depend on the type of area separation assembly that is used between attached units. Some assemblies such as shaft liner areas separation walls are fairly tight from unit to unit and leak substantially to the outdoors while others promote leakage between units, common spaces, and other defined unconditioned spaces in the building. An enclosure test for attached dwellings allows for identification of the most cost-effective air sealing option per assembly that is chosen.

- Air sealing of exterior walls in mid to large size single family homes has become cost effective, repeatable, and achievable. Small volume homes don’t have the same opportunities for sealing as volume is the primary driver not the number or size of holes to the exterior. Therefore, multiple re-inspections are needed and additional application of air sealing measures to chase down very small reductions in air leakage that still don’t result in passing 3 and in some cases 5 ACH occur. A more reasonable metric for small volume dwelling would result in more passing units and less re-inspections while still meeting the tightness goals of the code.

- In attached housing there is an additional fire and air separation wall, floor, and or ceiling where often only a limited amount of air sealing is allowed. However, with a reasonable metric such a 0.30 CFM/ft² of enclosure area one is looking at the entire surface area. This creates parity with single family homes as they have the opportunity to address all surfaces of the dwelling when seeking to reduce the infiltration rate to pass the requirements of code.

- The value of allowing an exception to use 0.30 CFM/ft² of enclosure area is that air-sealing varies directly with the amount of surface area. Two dwellings can have surface area that differs by 15%, but still have the same volume and the current metric offers the same leakage allowance. If the surface area can be addressed in the measurement than the playing field is leveled and attached small volume dwelling units would not have the problems passing the IECC.
IECC:  R402.4.1.2 (IRC N1102.4.1.2)

Proponent: Roger Papineau, Self, representing Self (hbagta.codeguy@gmail.com)

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R402.4.1.2 (IRC N1102.4.1.2) Testing. The building or dwelling unit shall be tested and verified as having an air leakage rate not exceeding five air changes per hour in Climate Zones 1 and 2, and three air changes per hour in Climate Zones 3 through 8. Testing shall be conducted in accordance with RESNET/ICC 380, ASTM E 779 or ASTM E 1827 and reported at a pressure of 0.2 inch w.g. (50 Pascals). Where required by the code official, testing shall be conducted by an approved third party. A written report of the results of the test shall be signed by the party conducting the test and provided to the code official. Testing shall be performed at any time after creation of all penetrations of the building thermal envelope.

During testing:

1. Exterior windows and doors, fireplace and stove doors shall be closed, but not sealed, beyond the intended weatherstripping or other infiltration control measures.
2. Dampers including exhaust, intake, makeup air, backdraft and flue dampers shall be closed, but not sealed beyond intended infiltration control measures.
3. Interior doors, where installed at the time of the test, shall be open.
4. Exterior or interior terminations for continuous ventilation systems shall be sealed.
5. Heating and cooling systems, where installed at the time of the test, shall be turned off.
6. Supply and return registers, where installed at the time of the test, shall be fully open.

Exception: For additions and alterations, the air barrier and insulation shall be inspected in accordance with TABLE R402.4.1.1.

Reason: Some building officials are refusing to accept reports from certified blower door test providers. This requirement may create for-profit third party companies. Exception. There is no economical prescriptive method of separating the existing structure from the new work. The common wall, or floor/ceiling have no air leakage requirements and therefore could create false ACH results.

Cost Impact: The code change proposal will decrease the cost of construction This may result in cost savings by eliminating unreliable testing.
Add new definition as follows:

**DWELLING UNIT ENCLOSURE AREA.** The sum of the area of ceiling, floors, and walls separating a dwelling unit's conditioned space from the exterior or from adjacent conditioned or unconditioned spaces. Wall height shall be measured from the finished floor of the dwelling unit to the underside of the floor above.

Revise as follows:

R402.4.1.2 (IRC N1102.4.1.2) **Testing.** The building or dwelling unit shall be tested and verified as having an air leakage rate not exceeding five air changes per hour or 0.28 cubic feet per minute (CFM) per square foot (ft²) of dwelling unit enclosure area in Climate Zones 1 and 2, and three air changes per hour or 0.17 CFM per (ft²) of dwelling unit enclosure area in Climate Zones 3 through 8. Testing shall be conducted in accordance with RESNET/ICC 380, ASTM E 779 or ASTM E 1827 and reported at a pressure of 0.2 inch w.g. (50 Pascals). Where required by the code official, testing shall be conducted by an approved third party. A written report of the results of the test shall be signed by the party conducting the test.

**Reason:** Air changes per hour (ACH) is a volumetric metric that is useful for air quality measurements in buildings but is not the correct expression of air leakage from an energy or building durability perspective. This proposal introduces the ability to use an alternative cubic foot per minute (CFM) per square foot (ft²) of dwelling unit enclosure area metric for measuring air leakage in a building. In this way, the air leakage measured at 50 Pascals divided by the building surface area is used to assess the airtightness of the construction and building envelope. Unlike ACH, a CFM/ft² of dwelling unit enclosure area metric normalizes the building air leakage per unit of building envelope surface area; the actual location where air is infiltrating or exfiltrating the building. To this end, the proposal also defines “Dwelling Unit Enclosure Area” as the sum of the area of ceiling, floors, and walls separating a dwelling unit's conditioned space from the exterior or from adjacent conditioned or unconditioned spaces. In addition, the definition offers guidance to further understand the measurement that must take place to calculate the dwelling unit enclosure area. This guidance states that the wall height shall be measured from the finished floor of the dwelling unit to the underside of the floor above. Lastly, the proposal ensures that the intent of the code, to ensure that the structure is built tight and ventilated correctly with mechanical ventilation, is maintained. If an additional option is adopted into the code, as proposed, then ventilation must also be ensured regardless of how air tightness of the structure is expressed.

Since 1980, The Energy Conservatory, has not only been a leader in air leakage science, but also one of the prominent manufacturers of the blower door air measurement tool. In their article, “Which Is A Better Metric For Measuring Airtightness: ACH @ 50 Pa Or CFM/ ft² Of Surface Area @ 50 Pa?”, which is adapted and added to in this reason statement, we get the basis of the argument for the introduction of a new metric into the International Energy Conservation Code for the measurement of air leakage.

To paraphrase, when measuring the airtightness of a building the objective is to learn how much leakage is occurring across the building’s enclosure area. It is analogous to moisture permeability or the measurement of moisture across the building’s enclosure area and thermal transmittance, the rate at which heat is transferred across the building enclosure area. The rate of air leakage or tightness does not depend on the volume of the structure as defined by the building’s enclosure area but does depend on the holes associated with the surface area of the structure.
The permeability of a material is typically measured as the flow per area at a given pressure difference across the material. U value measurements are similar. If we want a metric to use to measure the airtightness quality of construction of the exterior enclosure of buildings, it makes sense to use a metric that equates flow to the size and number of holes in the building's thermal enclosure.

The article continues with an example to help demonstrate how volume is not proportional to surface area:

**Comparison between ACH50 and CFM50/ft² for a 2000 ft² home at 3 ACH50**

House is 50 X 40 X 8

Volume = 16,000 ft³

Surface Area = 50 X 40 X 2 + 180 X 8 = 5440 ft²

CFM50 = (3 X 16000)/60 = 800 CFM

CFM50/ft² = 800/5440 = 0.147 CFM50/ft²

Increase height to 2 story at 3 ACH50

House is 50 X 40 X 16 Volume = 32,000 ft³

Surface area = 50 X 40 X 2 + 180 X 16 = 6880 ft²

CFM50 = (3 X 32000)/60 = 1600 cfm

CFM50/ft² = 1600/6880 = 0.233 CFM50/ft²

In this example, when the volume is doubled, the surface area increased by 26%. And when the ACH50 stays the same, the CFM/ ft² of surface area increased by 58%. I have attached an Excel spreadsheet calculator that further defines the disconnect between ACH and CFM/ ft² of surface area to further elaborate the issue. In the attached calculator you can change the ratio of width and length of the building to see the effect on the resulting expressions of air leakage. An independent yet similar calculator can be found at this Residential Energy Dynamic link http://www.residentialenergydynamics.com/REDCalcFree/Tools/AirLeakageMetrics

The primary purpose of this code change proposal is to introduce the CFM/ft² of surface area metric into the code. Deciding on where to set the minimum allowable leakage rate is difficult largely due to the earlier volume and surface area discussion. Both tests are performed at a pressure differential of 0.2 inch water gauge (50 Pa), which is the traditional residential testing pressure so an attempt was made to align the introduction of a CFM/ft² of surface area metric with the existing ACH50 metric of 3 and 5 air changes per hour. ACH being a volumetric measurement penalized small volume dwelling units so a decision was made to concentrate on a size range of dwellings between 2500 and 5500 square feet. By doing this and using the attached conditioned floor space to shell area calculator we were able to see that little variation occurred between ACH and CFM/ft² of surface area metric when changing the size ratio of the modeled house within this house size range. By rounding up, the proposal is using .17 CFM/ft² of surface area metric to align with 3 ACH and .28 CFM/ft² of surface area metric to align with 5 ACH. By using these numbers, small volume homes, while not having a volumetric penalty, are allowed to be a little more leaky and large volume homes must achieve just about the same level of tightness if not a slight bit more. As the average home size in the United States is approximately just less than 2500 square feet this code change proposals purpose of introducing a better measurement metric without removing the codes traditional measurement methodology, provid additional flexibility while maintaining similar stringency.

The Energy Conservatory suggests that the use of Air Changes per Hour at 50 Pa (ACH50) started approximately 60 years ago by researchers who were interested in ways to predict the natural infiltration rate of buildings, which at the time was most commonly measured in Air Changes per Hour. At the time air quality in buildings was being studied and the metric made sense. If a pollutant is released in a building, the time for the concentration to decay by a certain percentage depends on the infiltration measured in air changes per hour. The analysis of a tracer gas decay test gives a result in air changes per hour. So, when they started measuring airtightness, for use in estimating natural infiltration in air changes per hour, it made sense to use ACH50 as the metric.

However, as discussed earlier, two homes with the same volume can have very different surface areas and holes associated with the building enclosure area.
Value is gained by including a surface area-based metric in that air-sealing varies directly with the amount of surface area not the amount of volume in the dwelling. Two buildings can have surface areas that differ by 15%, but have the same volume and the current metric offers the same leakage allowance. Therefore, if the purpose of measuring air leakage is to determine something about the construction quality, air leakage rate, energy efficiency and building durability the metric should be associated with the flow of air through holes in the enclosure. To quantify these things ACH is the wrong metric. It does not tell you anything about the quantity and air leakage through holes in the building. Conversely, the CFM/ft² of surface area metric concretely expresses the quantity of air leakage through the building’s exterior enclosure. When an enclosure is tight more energy is conserved as well as allowing better control and predictability of air flow, thermal flow, and moisture flow.

Many standards are now using square foot of enclosure area instead of ACH. Examples include EnergyStar, US Army Corp of Engineers, LEED, US Passive House and ASHRAE 62.2. This proposal is the first step to bring this better expression of air leakage into the code. It has been created in such a way that options are maintained allowing jurisdictions and building professionals flexibility in defining air leakage requirements.

Link to Energy Conservatory article from which portions of this reason statement have been added:
https://support.energyconservatory.com/hc/en-us/articles/204176240-Which-is-a-better-metric-for-measuring-airtightness-ACH-50-Pa-or-CFM-ft-of-surface-area-50-Pa-

Why the change to R403.6?
It was pointed out in the last code cycle, that this metric could have an unintended loophole since it is not used in the IRC. To avoid that, the section was edited to to ensure whole house mechanical ventilation continues to be required and installed.

Why The change to IRC 303.4?
It was pointed out in the last code cycle, that this metric could have an unintended loophole since it is not used in the IRC. To avoid that, the section was edited to ensure whole house mechanical ventilation continues to be required and installed. In a companion change RB71-19, I have proposed changes to IRC R303.4 as a correlary to this change in the IECC.

Cost Impact: The code change proposal will not increase or decrease the cost of construction. There should be no cost implication associated with the adoption of this proposed language. Dwellings will continue to need to be tested and testing prices will not change due to an additional option for how to express the results of the test.

Proposal # 5276

RE90-19
IIECC: R202 (IRC N1101.6), R402.4.1.2 (IRC N1102.4.1.2), R403.6 (IRC N1103.6)

Proponent: Gayathri Vijayakumar, Steven Winter Associates, Inc., representing Steven Winter Associates, Inc. (gayathri@swinter.com); Joseph Lstiburek, Building Science Corporation, representing self (joe@buildingscience.com); Joel Martell, NAHB, representing NAHB (jmartell@nahb.org); Robby Schwarz, EnergyLogic, representing EnergyLogic (robby@nrglogic.com); Mike Moore, Newport Ventures, representing Broan-NuTone (mmoore@newportventures.net)

2018 International Energy Conservation Code

SECTION R202 (IRC N1101.6)
GENERAL DEFINITIONS

DWELLING UNIT. A single unit providing complete independent living facilities for one or more persons, including permanent provisions for living, sleeping, eating, cooking and sanitation.

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

Add new definition as follows:

DWELLING UNIT ENCLOSURE AREA. The sum of the areas of the walls, floors, ceilings, and any other building element assemblies that enclose the conditioned space of the dwelling unit or provide a boundary between the conditioned space of the dwelling unit and exterior or adjacent conditioned or unconditioned spaces.

R402.4 (IRC N1102.4) Air leakage (Mandatory). The building thermal envelope shall be constructed to limit air leakage in accordance with the requirements of Sections R402.4.1 through R402.4.5.

R402.4.1 (IRC N1102.4.1) Building thermal envelope. The building thermal envelope shall comply with Sections R402.4.1.1 and R402.4.1.2. The sealing methods between dissimilar materials shall allow for differential expansion and contraction.

Revise as follows:

R402.4.1.2 (IRC N1102.4.1.2) Testing. The building or dwelling unit shall be tested and verified as having an air leakage rate not exceeding five air changes per hour in Climate Zones 1 and 2, and three air changes per hour in Climate Zones 3 through 8. Testing shall be conducted in accordance with RESNET/ICC 380, ASTM E 779 or ASTM E 1827 and reported at a pressure of 0.2 inch w.g. (50 Pascals).

Exception: For dwelling units other than detached one-family dwellings, an air leakage rate not exceeding 0.3 cfm per ft² of the dwelling unit enclosure area shall be an accepted alternative in all Climate Zones. Testing shall be conducted in accordance with ANSI/RESNET/ICC 380, ASTM E779 or ASTM E1827 and reported at a pressure of 0.2 inch w.g. (50 Pascals).

Where required by the code official, testing shall be conducted by an approved third party. A written report of the results of the test shall be signed by the party conducting the test and provided to the code official. Testing shall be performed at any time after creation of all penetrations of the building thermal envelope.

During testing:

1. Exterior windows and doors, fireplace and stove doors shall be closed, but not sealed, beyond the intended weatherstripping or other infiltration control measures.
2. Dampers including exhaust, intake, makeup air, backdraft and flue dampers shall be closed, but not sealed beyond intended infiltration control measures.
3. Interior doors, where installed at the time of the test, shall be open.
4. Exterior or interior terminations for continuous ventilation systems shall be sealed.
5. Heating and cooling systems, where installed at the time of the test, shall be turned off.
6. Supply and return registers, where installed at the time of the test, shall be fully open.

R403.6 (IRC N1103.6) Mechanical ventilation (Mandatory). Each dwelling unit shall be provided with ventilation that complies with the mechanical ventilation. The mechanical ventilation system shall comply with the requirements of the International Residential Code or International Mechanical Code, as applicable, or with other approved means of ventilation. Outdoor air intakes and exhausts shall have automatic or gravity dampers that close when the ventilation system is not operating.

Reason: Why allow a different metric than ACH50?
A surface area based metric is more appropriate than a volume based metric since air-sealing varies directly with the amount of surface area. Depending on the floor plan, two apartments can have total surface area that differ by 15-25%, but still have the same volume and floor area. The...
current volume-based metric (3 or 5 ACH50) results in the same maximum air leakage allowed for these two different apartments, yet one apartment has significantly more surface area which to seal, making it inherently more difficult to achieve compliance. While this logic holds true for detached homes as well, in this proposal, this metric is being proposed for attached units only. Other proposals have been submitted to propose this metric for detached homes as well.

Is this cfm50/ft2 metric used anywhere else?

The metric proposed in this "Exception" has been successfully used in above-code multifamily programs since 2005 (ENERGY STAR Multifamily High Rise, LEED, and Passive House). It is also used in the Commercial provisions of IECC (C402.5), but at 75 Pa instead of 50 Pa. For comparison, 0.3 cfm50/ ft2 of dwelling unit enclosure area proposed here is the same as the commercial requirements for EXTERIOR envelope (0.4 cfm75/ft2), but this proposal requires it on ALL surfaces of the apartment enclosure, resulting in dwelling units that are individually sealed as tight as a commercial building's exterior envelope.

Will this create a challenge for code officials or individuals conducting the tests?

This metric is already reported on many air leakage reports that code officials receive today, so there is no change in reporting or effort in conducting the tests. Testing results are measured in CFM50, not ACH50. This CFM50 test value is translated into multiple metrics, and just as easily can be translated to CFM50/ft2 as ACH50.

Will this result in more efficient buildings?

While many focus on air leakage to the outdoors, air leakage within a multifamily building also results in energy losses. Conditioned air can leak to/from a dwelling unit to another vacant (unconditioned) unit, or the unheated stairwell or elevator shaft, the non conditioned corridor, or laundry room.

This proposal seeks to provide a reasonable alternative metric that will encourage builders to air seal and test successfully at the dwelling unit level instead of testing at the building level and potentially missing significant leakage pathways within the building that cause energy loss. Testing at the dwelling unit will result in tighter dwelling units and in the process, tighter buildings.

Why the change to R403.6?

It was pointed out in the last code cycle, that this metric could have an unintended loophole since it is not used in the IRC. To avoid that, the section was edited to avoid any potential loophole.

Cost Impact: The code change proposal will not increase or decrease the cost of construction Since this metric is simply an alternative to the current dwelling unit tests allowed, there is no change in costs.
**RE92-19**

IECC: SECTION R202, (New), R402.4, R402.4.1.2, SECTION R403, R403.6

**Proponent:** Robby Schwarz, EnergyLogic, representing EnergyLogic (robby@nrglogic.com)

**2018 International Energy Conservation Code**

**SECTION R202 (IRC N1101.6)**

**GENERAL DEFINITIONS**

Add new text as follows:

**DWELLING UNIT ENCLOSURE AREA.** The sum of the area of ceiling, floors, and walls separating a dwelling unit's conditioned space from the exterior or from adjacent conditioned or unconditioned spaces. Wall height shall be measured from the finished floor of the dwelling unit to the underside of the floor above.

Revise as follows:

**R402.4 (IRC N1101.6) Air leakage (Mandatory).** The building thermal envelope shall be constructed to limit air leakage in accordance with the requirements of Sections R402.4.1 through R402.4.5.

**R402.4.1.2 (IRC N1102.4.1.2) Testing.** The building or dwelling unit shall be tested and verified as having an air leakage rate not exceeding five air changes per hour or 0.28 cubic feet per minute (CFM) per square foot (ft²) of dwelling unit enclosure area in Climate Zones 1 and 2, and three air changes per hour or 0.17 CFM per (ft²) of dwelling unit enclosure area in Climate Zones 3 through 8. Testing shall be conducted in accordance with RESNET/ICC 380, ASTM E 779 or ASTM E 1827 and reported at a pressure of 0.2 inch w.g. (50 Pascals). Where required by the code official, testing shall be conducted by an approved third party. A written report of the results of the test shall be signed by the party conducting the test and provided to the code official. Testing shall be performed at any time after creation of all penetrations of the building thermal envelope.

During testing:

1. Exterior windows and doors, fireplace and stove doors shall be closed, but not sealed, beyond the intended weatherstripping or other infiltration control measures.
2. Dampers including exhaust, intake, makeup air, backdraft and flue dampers shall be closed, but not sealed beyond intended infiltration control measures.
3. Interior doors, where installed at the time of the test, shall be open.
4. Exterior or interior terminations for continuous ventilation systems shall be sealed.
5. Heating and cooling systems, where installed at the time of the test, shall be turned off.
6. Supply and return registers, where installed at the time of the test, shall be fully open.

**SECTION R403 (IRC N1103)**

**SYSTEMS**

**R403.6 (IRC N1103.6) Mechanical ventilation (Mandatory).** Each dwelling unit shall be provided with mechanical ventilation that complies. The mechanical ventilation system shall comply with the requirements of the International Residential Code or International Mechanical Code, as applicable, or with other approved means of ventilation. Outdoor air intakes and exhausts shall have automatic or gravity dampers that close when the ventilation system is not operating.

**Reason:** Air changes per hour (ACH) is a volumetric metric that is useful for air quality measurements in buildings but is not the correct expression of air leakage from an energy or building durability perspective. This proposal introduces the ability to use an alternative cubic foot per minute (CFM) per square foot (ft²) of dwelling unit enclosure area metric for measuring air leakage in a building. In this way, the air leakage measured at 50 Pascals divided by the building surface area is used to assess the airtightness of the construction and building envelope. Unlike ACH, a CFM/ ft² of dwelling unit enclosure area metric normalizes the building air leakage per unit of building envelope surface area; the actual location where air is infiltrating or exfiltrating the building. To this end, the proposal also defines “Dwelling Unit Enclosure Area” as the sum of the area of ceiling, floors, and walls separating a dwelling unit’s conditioned space from the exterior or from adjacent conditioned or unconditioned spaces. In addition, the definition offers guidance to further understand the measurement that must take place to calculate the dwelling unit enclosure area. This guidance states that the wall height shall be measured from the finished floor of the dwelling unit to the underside of the floor above. Lastly, the proposal ensures that the intent of the code, to ensure that the structure is built tight and ventilated correctly with mechanical ventilation, is maintained. If an additional option is adopted into the code, as proposed, then ventilation must also be ensured regardless of how air tightness of the structure is expressed.

Since 1980, The Energy Conservatory, has not only been a leader in air leakage science, but also one of the prominent manufacturers of the blower door air measurement tool. In their article, “Which Is A Better Metric For Measuring Airtightness: ACH @ 50 Pa Or CFM/ Ft² Of Surface Area @ 50 Pa?”, which is adapted and added to in this reason statement, we get the basis of the argument for the introduction of a new metric into the International Energy Conservation Code for the measurement of air leakage.
To paraphrase, when measuring the airtightness of a building the objective is to learn how much leakage is occurring across the building's enclosure area. It is analogous to moisture permeability or the measurement of moisture across the building's enclosure area and thermal transmittance, the rate at which heat is transferred across the building enclosure area. The rate of air leakage or tightness does not depend on the volume of the structure as defined by the building's enclosure area but does depend on the holes associated with the surface area of the structure. Air permeability of a material is typically measured as the flow per area at a given pressure difference across the material. U value measurements are similar. If we want a metric to use to measure the airtightness quality of construction of the exterior enclosure of buildings it makes sense to use a metric that equates flow to the size and number of holes in the building's thermal enclosure.

The article continues with an example to help demonstrate how volume is not proportional to surface area:

Comparison between ACH50 and CFM50/ft² for a 2000 ft² home at 3 ACH50

House Is 50 X 40 X 8

Volume = 16,000 ft³

Surface Area = 50 X 40 X 2 + 180 X 8 = 5440 ft²

CFM50 = (3 X 16000)/60 = 800 CFM

CFM50/ft² = 800/5440 = 0.147 CFM50/ft²

Increase height to 2 story at 3 ACH50

House Is 50 X 40 X 16 Volume = 32,000 ft³

Surface area = 50 X 40 X 2 + 180 X 16 = 6880 ft²

CFM50 = (3 X 32000)/60 = 1600 cfm

CFM50/ft² = 1600/6880 = 0.233 CFM50/ft²

In this example, when the volume is doubled, the surface area increased by 26%. And when the ACH50 stays the same, the CFM/ ft² of surface area increased by 58%. I have attached an Excel spreadsheet calculator that further defines the disconnect between ACH and CFM/ ft² of surface area to further elaborate the issue. In the attached yet similar calculator can be found at this Residential Energy Dynamic link http://www.residentialenergydynamics.com/REDCalcFree/Tools/AirLeakageMetrics

The primary purpose of this code change proposal is to introduce the CFM/ft² of surface area metric into the code. Deciding on where to set the minimum allowable leakage rate is difficult largely due to the earlier volume and surface area discussion. Both tests are performed at a pressure differential of 0.2 inch water gauge (50 Pa), which is a the traditional residential testing pressure so an attempt was made to align the introduction of a CFM/ft² of surface area metric with the existing ACH50 metric of 3 and 5 air changes per hour. ACH being a volumetric measurement penalized small volume dwelling units so a decision was made to concentrate on a size range of dwellings between 2500 and 5500 square feet. By doing this and using the attached conditioned floor space to shell area calculator we were able to see that little variation occurred between ACH and CFM/ft² of surface area metric when changing the size ratio of the modeled house within this house size range. By rounding up, the proposal is using .17 CFM/ft² of surface area metric to align with 3 ACH and .28 CFM/ft² of surface area metric to align with 5 ACH. By using these numbers, small volume homes, while not having a volumetric penalty, are allowed to be a little more leaky and large volume homes must achieve just about the same level of tightness if not a slight bit more. As the average home size in the United States is approximately just less than 2500 square feet this code change proposals purpose of introducing a better measurement metric without removing the codes traditional measurement methodology, provide additional flexibility while maintaining similar stringency.

The Energy Conservatory suggests that the use of Air Changes per Hour at 50 Pa (ACH50) started approximately 60 years ago by researchers who were interested in ways to predict the natural infiltration rate of buildings, which at the time was most commonly measured in Air Changes per Hour. At the time air quality in buildings was being studied and the metric made sense. If a pollutant is released in a building, the time for the concentration to decay by a certain percentage depends on the infiltration measured in air changes per hour. The analysis of a tracer gas decay test gives a result in air changes per hour. So, when they started measuring airtightness, for use in estimating natural infiltration in air changes per hour, it made sense to use ACH50 as the metric.

However, as discussed earlier, two homes with the same volume can have very different surface areas and holes associated with the building.
enclosure area.

Value is gained by including a surface area-based metric in that air-sealing varies directly with the amount of surface area not the amount of volume in the dwelling. Two buildings can have surface areas that differs by 15%, but have the same volume and the current metric offers the same leakage allowance. Therefore, if the purpose of measuring air leakage is to determine something about the construction quality, air leakage rate, energy efficiency and building durability the metric should be associated with the flow of air through holes in the enclosure. To quantify these things ACH is the wrong metric. It does not tell you anything about the quantity and air leakage through holes in the building. Conversely, the CFM/ ft² of surface area metric concretely expresses the quantity of air leakage throught the building’s exterior enclosure. When an enclosure is tight more energy is conserved as well as allowing better control and predictability of air flow, thermal flow, and moisture flow.

Many standards are now using square foot of enclosure area instead of ACH. Examples include EnergyStar, US Army Corp of Engineers, LEED, US Passive House and ASHRAE 62.2. This proposal is the first step to bring this better expression of air leakage into the code. It has been created in such a way that options are maintained allowing jurisdictions and building professionals flexibility in defining air leakage requirements.

Link to Energy Conservatory article from which portions of this reason statement have been added:

https://support.energyconservatory.com/hc/en-us/articles/204176240-Which-is-a-better-metric-for-measuring-aitightness-ACH-50-Pa-or-CFM-ft-of-surface-area-50-Pa-

Cost Impact: The code change proposal will not increase or decrease the cost of construction
There should be no cost implication associated with the adoption of this proposed language. Dwellings will continue to need to be tested and testing prices will not change due to an additional option for how to express the results of the test.

Proposal # 4783

RE92-19
IECC: R402.4.1.2 (IRC N1102.4.1.2)

**Proponent:** Aaron Gary, representing Self (aaron.gary@texenergy.org)

**2018 International Energy Conservation Code**

Revise as follows:

**R402.4.1.2 (IRC N1102.4.1.2) Testing.** The building or dwelling unit shall be tested and verified as having an air leakage rate not exceeding five air changes per hour, or 0.32 cfm/ft² of enclosure bounding the dwelling for dwellings 1,600 square feet or less, in Climate Zones 1 and 2, and three air changes per hour, or 0.23 cfm/ft² of enclosure bounding the dwelling for dwellings 1,600 square feet or less, in Climate Zones 3 through 8. Testing shall be conducted in accordance with RESNET/ICC 380, ASTM E 779 or ASTM E 1827 and reported at a pressure of 0.2 inch w.g. (50 Pascals).

Where required by the code official, testing shall be conducted by an approved third party. A written report of the results of the test shall be signed by the party conducting the test and provided to the code official. Testing shall be performed at any time after creation of all penetrations of the building thermal envelope.

**During testing:**

1. Exterior windows and doors, fireplace and stove doors shall be closed, but not sealed, beyond the intended weatherstripping or other infiltration control measures.
2. Dampers including exhaust, intake, makeup air, backdraft and flue dampers shall be closed, but not sealed beyond intended infiltration control measures.
3. Interior doors, where installed at the time of the test, shall be open.
4. Exterior or interior terminations for continuous ventilation systems shall be sealed.
5. Heating and cooling systems, where installed at the time of the test, shall be turned off.
6. Supply and return registers, where installed at the time of the test, shall be fully open.

**Reason:** All homes and apartments are required to be built tight. What is the most appropriate measurement of tightness is open for debate even within the Code where the metric is dependent on which section being referenced. The different metrics are important though because none of them are perfect and some are more applicable to one building type or another. For example, we believe that small homes and apartments are penalized by the ACH metric. A home that is 1,600 sq. feet vs. a home that is 3,000 sq. feet can have the same level of attention to detail regarding the air sealing of a home, yet due to the decreased volume of the smaller home, the smaller dwelling will have a much harder time meeting its ACH target. When volume is the deciding factor in the air leakage, this will always be the case. This built-in bias for larger homes with the ACH metric is because the ratio of surface area of the envelope (or walls bounding the dwelling) to the volume is not a linear relationship. Further the number of penetrations required by Code that can not be sealed effectively (exhaust ducts, mechanical ventilation intakes, fire-sprinkler penetrations, etc.) and the instances of penetrations that result in inadvertent leakage (plumbing penetrations, electrical penetrations, windows, doors, etc.) may be similar for a small dwelling as a large dwelling. For example: A house that is 1,000 square feet or 6,000 square feet will most often have one kitchen with all its associated openings and penetrations.

The infiltration metric we are proposing is derived from the ACH equivalencies accepted in ICC 700-2020 (which is currently in its first Public Comment). We are proposing that this equivalency only be accepted for dwellings under 1,600 sq. ft. though because 1) we believe the small dwellings are the ones being penalized by the ACH metric and 2) this leakage metric would result is less stringent leakage targets at larger dwelling volumes.

**Cost Impact:** The code change proposal will not increase or decrease the cost of construction.

This code change will decrease the cost of construction for dwellings under 1600 sq. ft. by setting a air leakage target that is meaningful and achievable.
2018 International Energy Conservation Code

R402.4 Air leakage (Mandatory). The building thermal envelope shall be constructed to limit air leakage in accordance with the requirements of Sections R402.4.1 through R402.4.5.

R402.4.1.2 Testing. The building or dwelling unit shall be tested and verified as having an air leakage rate not exceeding five air changes per hour in Climate Zones 1 and 2, and three air changes per hour in Climate Zones 3 through 8. Testing shall be conducted in accordance with RESNET/ICC 380, ASTM E 779 or ASTM E 1827 and reported at a pressure of 0.2 inch w.g. (50 Pascals). Where required by the code official, testing shall be conducted by an approved third party. A written report of the results of the test shall be signed by the party conducting the test and provided to the code official. Testing shall be performed at any time after creation of all penetrations of the building thermal envelope.

During testing:

1. Exterior windows and doors, fireplace and stove doors shall be closed, but not sealed, beyond the intended weatherstripping or other infiltration control measures.
2. Dampers including exhaust, intake, makeup air, backdraft and flue dampers shall be closed, but not sealed beyond intended infiltration control measures.
3. Interior doors, where installed at the time of the test, shall be open.
4. Exterior or interior terminations for continuous ventilation systems shall be sealed.
5. Heating and cooling systems, where installed at the time of the test, shall be turned off.
6. Supply and return registers, where installed at the time of the test, shall be fully open.

Add new text as follows:

R402.4.1.3 (IRC N1102.4.1.3) Testing Garage Separation. The integrity of the air barrier assembly between dwelling units and attached garages shall pass a two-part test:

1. While conducting the air leakage test as described in Section R402.4.1.2 the air barrier separation between the house and the garage shall be tested to ensure that the house in reference to the garage is ≥ 45 Pascals of pressure when the house is held at 50 Pascals of pressure in relation to outside. All operable garage openings to the outside shall be closed during the test.
2. If test number 1 passes, the test shall be performed a second time with the garage vehicle door open to the ambient outside. The two test results shall not differ by more than 6 percent.

Reason: The energy code, like all code, is about health, safety, comfort, durability, as well as efficiency. The garage is the largest potential source of pollutants and carbon monoxide in the house and it has been codified in table R402.4.1.1 to ensure that the air in the garage is separated from the house. Air from an attached garage can enter the living space of the home if there are bypasses in the air barrier between the two spaces and if the home is at a negative pressure with respect to the garage. Negative pressures may be due to natural forces or to mechanical depressurization of the house with respect to the garage caused by appliances like rangehood fans, clothes dryers, bath fans, crawlspace ventilation or whole house ventilation systems, as well as, unbalanced HVAC systems. Unfortunately, there is no way to be sure that separation has been achieved, in this location, unless the separation is tested. Fortunately testing for separation between the house and garage is simple and is made even more practical due to the requirement to blower door test for every home. The surest way to keep garage pollutants out of the house is to build a detached garage. Since most houses are designed with attached garages, planning ahead of construction to make sure a continuous air barrier is installed between the house and the garage makes sense. This proposal will promote such planning.

To ensure that there is not a false positive result Building America research has determined that the test requires two steps. First, while the house is at 50 Pascals of pressure with regards to outside during the blower door test a zonal pressure test is performed by installing a tube between the house and the garage. (Usually under the door between the house and the garage) If the garage is clearly outside, the measurement between the house and the garage should also be 50 Pascals of pressure. The closer the measurement is to zero the more connected the garage is to the house. This code proposal requires that the results of the first test be ≥ 45 pascals which is an indication that the air barrier assembly between the house and garage is sound. The first test is performed when all openings between the garage and the outside are closed. Second, this test is repeated with the overhead vehicle door open. If the results of the second test are greater than 6% the connection between the house and the garage tests fails. The rationale for the second test is to guard against false positive results that can occur while performing the first test.

If we continue to require separation between the house and the garage from an energy efficiency perspective, we must also test to ensure it from a health and safety perspective in order to maintain the intent of the IECC. Programs such as the EPA Indoor Air Plus and the DOE Zero Energy Ready Home program have incorporated the protocol described above to test for this separation. In addition, Jurisdictions around the country, such as Fort Collins Colorado have amended the IECC to require this test as they realize the energy and health and safety implications.
People have asked if garage separation is really an issue. Past research, as pointed out in the Building America Program research paper titled “Air Leakage and Air Transfer between Garage and Living Space” says yes. An excerpt of a study done by S.J. Emmerich used in the Building America paper, reports that polluted garage air infiltrated into living quarters was as much as 45% of total house infiltration. See the attached research paper for more evidence of carbon monoxide and other pollutants traveling between attached garages and the house and the bibliography of numerous studies that have documented that pollutants from the garage are capable of migrating into the house.

The problem is that one cannot know for sure if the garage is connected to the house unless one tests. The complexities of the assemblies separating the house and the garage, with dropped ceilings, pipe, ducts, wiring and who knows what else penetrating the buildings thermal envelope and air barrier systems, make it an extremely difficult part of the house to seal. What we do know is that automobiles are the largest source of carbon monoxide in our home and they are parked in attached garages. We also know that other pollutants such as gasoline, pesticides, and paints are stored in attached garages. Therefore, to not test is clearly against the health and safety intent of the code and ultimately places builders and homebuyers at risk.

Resources:

US Department of Energy Building Technologies Office

Building America Program

“Air Leakage and Air Transfer between Garage and Living Space”

Armin Rudd Building Science Corporation

September 2014

**Air Sealing and Insulating Garage Walls - Code Compliance Brief**


**Overview:**

The intent of this brief is to provide code-specific information about air sealing and insulating garage walls to help ensure that the measure will be accepted as being in compliance with the code. Providing notes for code officials on how to plan reviews and conduct field inspections can help builders or remodelers with proposed designs and installations and provide jurisdictional officials with information for acceptance. Providing the same information to all interested parties (e.g., code officials, builders, designers, etc.) is expected to result in increased compliance and fewer innovations being questioned at the time of plan review and/or field inspection.

As in other parts of the home, sealing and insulating the walls and ceiling of your garage can be an effective way to improve energy efficiency in a home. In addition, properly isolating and air sealing attached garages from the living space is critical for preventing the potential infiltration of carbon monoxide and other contaminants into the home. Open joist bays above the garage that extend into living spaces need to be blocked and air sealed at the garage wall. Seams along the rim joist, top plate, sill plate, and foundation wall should be caulked or sealed. If there is living space above the garage, extra care should be taken to seal all seams and any holes in the subfloor, and any doors between the house and the garage should be weather stripped and have a tight-fitting threshold sweep.

Insulation and air-sealing requirements for garage walls shared with conditioned space are found in the International Energy Conservation Code (IECC) and International Residential Code (IRC). Even though each version of the 2009, 2012, and 2015 IECC/IRC codes has included provisions that the **building thermal envelope** should be durably sealed to limit infiltration, the language related to air barriers and insulation in the 2009 version was somewhat vague and did not specify specific components of the **building thermal envelope**. The 2012 IECC/IRC added more specific language regarding areas of the **building thermal envelope** that should be sealed and expanded upon those areas that are now included in the 2015 IECC/IRC as well. This brief provides an overview of the 2009 through 2015 IRC/IECC code requirements related to air sealing and insulating attached garage walls.

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

The cost implication of this proposal is small as this test must be performed at the same time as the blower door test described in section R4052.4.1.2. The garage separation test will add approximately 15 minutes to the testing that is already being performed so may add between $25 and $50. If the test fails it is an indication that already required code air sealing scopes of work are not being performed properly. This should require greater attention to detail rather than additional cost from the air sealing contractor.
RE95-19

IECC: R402.4.1.3 (IRC N1102.4.1.3) (New), R402.4.1.3.1 (IRC N1102.4.1.3.1) (New), R402.4.1.3.2 (IRC N1102.4.1.3.2) (New)

Proponent: Aaron Gary, Tempo Partners, representing Self (aaron.gary@tempopartners.com)

2018 International Energy Conservation Code

Add new text as follows:

R402.4.1.3 (IRC N1102.4.1.3) Sampling options for R2 multifamily dwelling units. For buildings having three or more dwelling units, a minimum of 15% of the dwelling units in each building must be tested as required by Section R402.4.1.2. Prior to beginning sampling for testing, “Initial Testing” is required for each multifamily property. “Initial Testing” shall consist of the 3rd party testing contractor performing the required tests on at least three consecutive dwelling units. Test results from the “Initial Testing” must satisfy minimum code requirements before sampling is permitted. Dwelling units selected for the “Initial Testing” must be within the same building. Dwelling units selected for “Initial Testing” shall not be included in a “sample group” or counted toward the minimum 15% of dwelling units tested. The building official shall randomly select the three dwelling units for “Initial Testing.” The building official may delegate the random selection to the designated 3rd party testing contractor.

R402.4.1.3.1 (IRC N1102.4.1.3.1) Sample group Identification and Sampling. The builder shall identify a "sample group" which may be a building, floor, fire area or portion thereof. All of the dwelling units within the “sample group” must be at the same stage of construction and must be ready for testing. The building official shall randomly select at least 15% of dwelling units from each “sample group” for testing. The building official may delegate the random selection to the designated 3rd party testing contractor. If each tested dwelling unit within a “sample group” meets the minimum code requirements, then all dwelling units in the “sample group” are considered to meet the minimum code requirements.

Before a building may be deemed compliant with the testing as required, each “sample group” must be deemed compliant with the minimum code requirements. The sum total of all of the tested dwelling units across all “sample groups” shall not be less than a minimum of 15% of the dwelling units in a building.

R402.4.1.3.2 (IRC N1102.4.1.3.2) Failure to Meet Code Requirement(s). If any dwelling units within the identified “sample group” fail to meet a code requirement as determined by testing, the builder will be directed to correct the cause(s) of failure, and 30% of the remaining dwelling units in the “sample group” will be randomly selected for testing by the building official, or third-party testing contractor, regarding the specific cause(s) of failure. If any failures occur in the additional dwelling units, all remaining dwelling units in the sample group must be individually tested for code compliance.

A multifamily property with three failures within a 90-day period is no longer eligible to use the sampling protocol in that community or project until successfully repeating “Initial Testing.” Sampling may be reinstated after at least three consecutive dwelling units are individually verified to meet all code requirements.

A Certificate of Occupancy may not may be issued for any building until testing has been performed and deemed to satisfy the minimum code requirements on the dwelling unit(s) identified for testing.

Reason: For many multifamily (R2 classifications) projects, it is very costly and time consuming to test each dwelling unit for projects where there may be dozens of dwelling units in each building. Considering that the same tradesman generally constructs a building, it is reasonable to deem that construction practices are consistent and that if a reasonable sampling of units tested pass then all units would pass. These amendments (originally drafted by the North Texas Council of Governments Energy and Green Advisory Board) or are very similar ordinances, have been accepted across Texas by the EHJs including the City of Dallas, the City of Austin, and the City of San Antonio.

Cost Impact: The code change proposal will decrease the cost of construction

This code change proposal will streamline the cost and time required to conduct on-site verification of Code which will result in lower testing costs and faster construction timelines.

Proposal # 4588

RE95-19

RE175
Proponent: William Fay, Energy-Efficient Codes Coalition, representing Energy-Efficient Codes Coalition (bfay@ase.org); Daniel Bresette, Alliance to Save Energy, representing Alliance to Save Energy (dbresette@ase.org); Maureen Gutman, BCAP-IBTS, representing BCAP-IBTS (mgutman@bcapcodes.org); Harry Misuriello, American Council for an Energy-Efficient Economy, representing American Council for an Energy-Efficient Economy (misuriello@verizon.net)

### 2018 International Energy Conservation Code

**Revise as follows:**

**R402.4 (IRC N1102.4) Air leakage (Mandatory).** The building thermal envelope shall be constructed to limit air leakage in accordance with the requirements of Sections R402.4.1 through R402.4.5.

**R402.4.1 (IRC N1102.4.1) Building thermal envelope.** The building thermal envelope shall comply with Sections R402.4.1.1 and R402.4.1.2 through R402.4.1.3. The sealing methods between dissimilar materials shall allow for differential expansion and contraction.

**R402.4.1.1 (IRC N1102.4.1.1) Installation (Mandatory).** The components of the building thermal envelope as indicated in Table R402.4.1.1 shall be installed in accordance with the manufacturer’s instructions and the criteria indicated in Table R402.4.1.1, as applicable to the method of construction. Where required by the code official, an approved third party shall inspect all components and verify compliance.

**R402.4.1.2 (IRC N1102.4.1.2) Testing (Mandatory).** The building or dwelling unit shall be tested and verified as having an air leakage rate not exceeding five air changes per hour in Climate Zones 1 and 2, and three air changes per hour in Climate Zones 3 through 8, for air leakage. The maximum air leakage rate for any building or dwelling unit under any compliance path shall not exceed 5.0 air changes per hour. Testing shall be conducted in accordance with RESNET/ICC 380, ASTM E 779 or ASTM E 1827 and reported at a pressure of 0.2 inch w.g. (50 Pascals). Where required by the code official, testing shall be conducted by an approved third party. A written report of the results of the test shall be signed by the party conducting the test and provided to the code official. Testing shall be performed at any time after creation of all penetrations of the building thermal envelope.

During testing:

1. Exterior windows and doors, fireplace and stove doors shall be closed, but not sealed, beyond the intended weatherstripping or other infiltration control measures.
2. Dampers including exhaust, intake, makeup air, backdraft and flue dampers shall be closed, but not sealed beyond intended infiltration control measures.
3. Interior doors, where installed at the time of the test, shall be open.
4. Exterior or interior terminations for continuous ventilation systems shall be sealed.
5. Heating and cooling systems, where installed at the time of the test, shall be turned off.
6. Supply and return registers, where installed at the time of the test, shall be fully open.

Add new text as follows:

**R402.4.1.3 (IRC N1102.4.1.3) Leakage Rate (Prescriptive).** The building or dwelling unit shall have an air leakage rate not exceeding 5.0 air changes per hour in Climate Zones 1 and 2, and 3.0 air changes per hour in Climate Zones 3 through 8, when tested in accordance with Section R402.4.1.2.

**Reason:** The purpose of the code change proposal is to increase flexibility by modifying the mandatory value for air leakage to permit limited trade-off against other features of the home and establishing a prescriptive value at the same level as the current mandatory value. Specifically, the proposal would allow a trade-off option for air tightness up to 5 ACH50, while maintaining the baseline prescriptive value for trade-offs at 3 ACH50 in climate zones 3-8.

Because the current air leakage requirements are mandatory, builders have limited recourse if a finished home fails to meet the required leakage level or if the size or design features of the home make air tightness more challenging. This proposal will allow air leakage to be traded off up to a designated maximum level through either the performance path or the ERI, as long as builders account for the efficiency losses by improving other building components. If a builder believes that the particular design characteristics or size of a home or dwelling unit will make it more difficult to achieve 3 ACH50, this flexibility will allow the builder to hedge against a failure to meet the prescriptive leakage by implementing modest improvements elsewhere in the home and complying by the performance path or ERI.

This change should improve adoption and enforcement of the code requirements. The proposal responds to complaints that the current mandatory level of air leakage at 3 ACH is too stringent in some cases. It will allow jurisdictions to adopt the 3 ACH requirement with the recognition that if a builder has difficulty meeting it, they have other compliance options. Moreover, this proposal makes the code's air leakage requirements consistent with other requirements where there is a mandatory level at some value above the prescriptive level.
This proposal also clarifies the maximum air leakage rates as 3.0 and 5.0 air changes per hour. While most code users understand the maximum air leakage rates as already being at 3.0 and 5.0 changes per hour, the addition of another digit will pre-empt any “round up” vs. “round-down” arguments from code users, providing additional support for building code officials who are simply trying to enforce the code. This part of the proposal does not change any actual requirements, but rather provides clarification and reduces inconsistency and confusion.

**Cost Impact:** The code change proposal will not increase or decrease the cost of construction
The proposal is intended to be cost-neutral, but provide increased flexibility and improve compliance and enforcement. In some cases, builders may be able to reduce cost by trading off air leakage for other efficiency improvements.
RE97-19

IECC: R402.4.1.2 (IRC N1102.4.1.2)

Proponent: Aaron Gary, representing Self (aaron.gary@texenergy.org)

2018 International Energy Conservation Code
Revise as follows:

R402.4.1.2 (IRC N1102.4.1.2) Testing. The building or dwelling unit shall be tested and verified as having an air leakage rate not exceeding five air changes per hour in Climate Zones 1 and 2, and three air changes per hour in Climate Zones 3 through 8. Testing shall be conducted in accordance with RESNET/ICC 380, ASTM E 779 or ASTM E 1827 and reported at a pressure of 0.2 inch w.g. (50 Pascals). Where required by the code official, testing shall be conducted by an approved third party that is certified to perform air infiltration testing by a national or state organization. The third-party entity may not be employed, or have financial interest in the company that constructs the building or dwelling unit. A written report of the results of the test shall be signed by the party conducting the test and provided to the code official. Testing shall be performed at any time after creation of all penetrations of the building thermal envelope.

During testing:

1. Exterior windows and doors, fireplace and stove doors shall be closed, but not sealed, beyond the intended weatherstripping or other infiltration control measures.
2. Dampers including exhaust, intake, makeup air, backdraft and flue dampers shall be closed, but not sealed beyond intended infiltration control measures.
3. Interior doors, where installed at the time of the test, shall be open.
4. Exterior or interior terminations for continuous ventilation systems shall be sealed.
5. Heating and cooling systems, where installed at the time of the test, shall be turned off.
6. Supply and return registers, where installed at the time of the test, shall be fully open.

Reason: The International Residential Code (IRC) and International Energy Conservation Code (IECC) includes enhanced emphasis on envelope infiltration and duct leakage. Significant changes in the residential energy requirements include more frequent requirement of performance testing for leakage. Residential Duct systems must be tested unless all ducts and equipment are located within the conditioned space. Envelope testing is required to demonstrate compliance with maximum allowable leakage rate. This language puts the regulatory authority on notice that the testing requires specialized credentials and establishes a conflict of interest baseline.

Cost Impact: The code change proposal will not increase or decrease the cost of construction

The code change proposal will not increase or decrease the cost of construction.

Proposal # 4592
**2018 International Energy Conservation Code**

Revise as follows:

**R402.4.1.2 (IRC N1102.4.1.2) Testing.** The building or dwelling unit shall be tested and verified as having an air leakage rate not exceeding five air changes per hour in Climate Zones 1 and 2, and three air changes per hour in Climate Zones 3 through 8. Testing shall be conducted in accordance with RESNET/ICC 380, ASTM E 779 or ASTM E 1827 and reported at a pressure of 0.2 inch w.g. (50 Pascals). Where required by the code official, testing shall be conducted by an approved third party. A written report of the results of the test shall be signed by the party conducting the test and provided to the code official. Testing shall be performed at any time after creation of all penetrations of the building thermal envelope.

During testing:

1. Exterior windows and doors, fireplace and stove doors shall be closed, but not sealed, beyond the intended weatherstripping or other infiltration control measures.
2. Dampers including exhaust, intake, makeup air, backdraft and flue dampers shall be closed, but not sealed beyond intended infiltration control measures.
3. Interior doors, where installed at the time of the test, shall be open.
4. Exterior or interior terminations for continuous ventilation systems shall be sealed.
5. Heating and cooling systems, where installed at the time of the test, shall be turned off.
6. Supply and return registers, where installed at the time of the test, shall be fully open.

**TABLE R405.5.2(1) [IRC N1105.5.2(1)]**

SPECIFICATIONS FOR THE STANDARD REFERENCE AND PROPOSED DESIGNS

Portions of table not shown remain unchanged.

<table>
<thead>
<tr>
<th>BUILDING COMPONENT</th>
<th>STANDARD REFERENCE DESIGN</th>
<th>PROPOSED DESIGN</th>
</tr>
</thead>
<tbody>
<tr>
<td>Air exchange rate</td>
<td>The air leakage rate at a pressure of 0.2 inch w.g. (50 Pa) shall be: Climate Zones 1 and 2: 5.0 air changes per hour. Climate Zones 3 through 8: 3.0 air changes per hour. The mechanical ventilation rate shall be in addition to the air leakage rate and shall be the same as in the proposed design, but not greater than 0.01 × CFA + 7.5 × (N_{b} + 1) where: CFA = conditioned floor area, ft$^2$. $N_{b}$ = number of bedrooms. Energy recovery shall not be assumed for mechanical ventilation.</td>
<td>The measured air exchange rate.$^a$ The mechanical ventilation rate$^b$ shall be in addition to the air leakage rate and shall be as proposed.</td>
</tr>
</tbody>
</table>

For SI: 1 square foot = 0.93 m$^2$, 1 British thermal unit = 1055 J, 1 pound per square foot = 4.88 kg/m$^2$, 1 gallon (US) = 3.785 L,

$^a$ C = ($^\circ$F-32)/1.8, 1 degree = 0.79 rad.

- Where required by the code official, testing shall be conducted by an approved party. Hourly calculations as specified in the ASHRAE Handbook of Fundamentals, or the equivalent, shall be used to determine the energy loads resulting from infiltration.

**Reason:** The purpose of this code change proposal is to clarify the current requirements for maximum tested air leakage rates that are already part...
of the IECC and to ensure that buildings achieve the efficiency intended by the code. Specifically, the code proposal adds "0" to the specified requirements to clarify that values above 3.0 or 5.0 are not allowed. While most users understand based on the current language that the air leakage may not exceed 3 or 5 air changes per hour (depending on climate zone), the addition of another digit will pre-empt any claim that a tested value above these maximums, such as 5.4 ACH, will meet the 5 ACH maximum. By cutting off these “round off” arguments from code users, this change will provide additional support for building code officials who are simply trying to enforce the code. This proposed clarification will not change any substantive requirements of the code but will improve compliance and enforcement and eliminate any confusion.

**Cost Impact:** The code change proposal will not increase or decrease the cost of construction. It merely serves to clarify a current requirement to avoid confusion and inconsistent enforcement.
IECC: R402.4 (IRC N1102.4), R402.4.1.1 (IRC N1102.4.1.1), R402.4.1.2 (IRC N1102.4.1.2), R402.4.1.3 (IRC N1102.4.1.3) (New), R402.4.1.4 (IRC N1102.4.1.4)(New)

Proponent: Joel Martell, representing National Association of Home Builders (jmartell@nahb.org)

2018 International Energy Conservation Code

Revise as follows:

R402.4 (IRC N1102.4) Air leakage (Mandatory). The building thermal envelope shall be constructed to limit air leakage in accordance with the requirements of Sections R402.4.1 through R402.4.5.

R402.4.1.1 (IRC N1102.4.1.1) Installation (Mandatory). The components of the building thermal envelope as indicated in Table R402.4.1.1 shall be installed in accordance with the manufacturer’s instructions and the criteria indicated in Table R402.4.1.1, as applicable to the method of construction. Where required by the code official, an approved third party shall inspect all components and verify compliance.

R402.4.1.2 (IRC N1102.4.1.2) Testing (Mandatory). The building or dwelling unit shall be tested and verified as having an air leakage rate not exceeding five air changes per hour in Climate Zones 1 and 2, and three air changes per hour in Climate Zones 3 through 8. Testing shall be conducted in accordance with RESNET/ICC 380, ASTM E 779 or ASTM E 1827 and reported at a pressure of 0.2 inch w.g. (50 Pascals). Where required by the code official, testing shall be conducted by an approved third party. A written report of the results of the test shall be signed by the party conducting the test and provided to the code official. Testing shall be performed at any time after creation of all penetrations of the building thermal envelope.

During testing:

1. Exterior windows and doors, fireplace and stove doors shall be closed, but not sealed, beyond the intended weatherstripping or other infiltration control measures.
2. Dampers including exhaust, intake, makeup air, backdraft and flue dampers shall be closed, but not sealed beyond intended infiltration control measures.
3. Interior doors, where installed at the time of the test, shall be open.
4. Exterior or interior terminations for continuous ventilation systems shall be sealed.
5. Heating and cooling systems, where installed at the time of the test, shall be turned off.
6. Supply and return registers, where installed at the time of the test, shall be fully open.

Add new text as follows:

R402.4.1.3 (IRC N1102.4.1.3) Maximum Air Leakage (Mandatory). The maximum Air Leakage permitted shall be 6 ACH in Climate Zones 1 and 2, and 5 ACH in Climate Zones 3 through 8 when tested in accordance with Section R402.4.1.2.

R402.4.1.4 (IRC N1102.4.1.4) Air Leakage Rate (Prescriptive). The building or dwelling unit shall have an air leakage rate not exceeding 5 air changes per hour in Climate Zones 1 and 2, and 3 air changes per hour in Climate Zones 3 through 8, when tested in accordance with Section R402.4.1.2.

Reason: These modifications remove the mandatory maximum air-tightness requirement and provide designers and builders the flexibility to trade off building tightness with other performance path measures while also providing a limit to that flexibility. Currently the building tightness requirement is mandatory and the 3 and 5 ACH tightness levels, even under ideal circumstances, are very difficult to achieve. This will provide energy neutral tradeoffs for expensive and sometimes unattainable requirements with other building improvements. This proposal does not change the stringency or efficiency of the code; it only increases the flexibility.

DOE has verified that achieving 3 ACH50 is problematic, even in Maryland who has had a 3 ACH requirement for over 3 years (see chart below).
Cost Impact: The code change proposal will not increase or decrease the cost of construction. This proposal will not change the cost of construction only add flexibility.
RE100-19

IECC: R402.4.1.2 (IRC N1102.4.1.2), R402.2.13 (IRC N1102.2.13), R402.3.5 (IRC N1102.3.5)

Proponent: Darren Meyers, P.E., International Energy Conservation Consultants LLC, representing Self (dmeyers@ieccode.com)

2018 International Energy Conservation Code

Revise as follows:

R402.4.1.2 (IRC N1102.4.1.2) Testing. The building or dwelling unit shall be tested and verified as having an air leakage rate not exceeding five air changes per hour in Climate Zones 1 and 2, and three air changes per hour in Climate Zone 3 through 8. Testing shall be conducted in accordance with RESNET/ICC 380, ASTM E 779 or ASTM E 1827 and reported at a pressure of 0.2 inch w.g. (50 Pascals). Where required by the code official, testing shall be conducted by an approved third party. A written report of the results of the test shall be signed by the party conducting the test and provided to the code official. Testing shall be performed at any time after creation of all penetrations of the building thermal envelope have been sealed.

Exception: For heated, attached private garages and heated, detached private garages accessory to 1- and 2-family dwellings and townhouses not more than 3 stories above grade plane in height, building envelope tightness and insulation installation shall be considered acceptable where the items in Table R402.4.1.1, applicable to the method of construction, are field verified. Where required by the code official, an approved third party independent from the installer shall inspect both air barrier and insulation installation criteria. Heated, attached private garage space and heated, detached private garage space shall be thermally isolated from all other habitable, conditioned spaces in accordance with Sections R402.2.13 and R402.3.5, accordingly.

During testing:

1. Exterior windows and doors, fireplace and stove doors shall be closed, but not sealed, beyond the intended weatherstripping or other infiltration control measures.
2. Dampers including exhaust, intake, makeup air, backdraft and flue dampers shall be closed, but not sealed beyond intended infiltration control measures.
3. Interior doors, where installed at the time of the test, shall be open.
4. Exterior or interior terminations for continuous ventilation systems shall be sealed.
5. Heating and cooling systems, where installed at the time of the test, shall be turned off.
6. Supply and return registers, where installed at the time of the test, shall be fully open.

R402.2.13 (IRC N1102.2.13) Sunroom insulation. Sunrooms enclosing conditioned space and heated garages shall meet the insulation requirements of this code.

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

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

R402.3.5 (IRC N1102.3.5) Sunroom fenestration. Sunrooms and heated garages enclosing conditioned space shall comply with the fenestration requirements of this code.

Exception: In Climate Zones 2 through 8, for sunrooms and heated garages with thermal isolation and enclosing conditioned space, the fenestration U-factor shall not exceed 0.45 and the skylight U-factor shall not exceed 0.70. New fenestration separating the sunroom or heated garage with thermal isolation from conditioned space shall comply with the building thermal envelope requirements of this code.

Reason: We, in Illinois and Iowa, have found that the addition of a reasonable, provision regulating "heated garages," results in improved levels of compliance assessment.

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

It is likely that the creation of the thermally-isolated "heated garage" provisions will result in less "illegitimate" applications or "non-applications" for permit and inspection of newly heated, existing garages utilized for either hobby or workshop or rendering during hunting season.
RE101-19
IECC: R402.4.1.2 (IRC N1102.4.1.2)

Proponent: Darren Meyers, P.E., International Energy Conservation Consultants LLC, representing Self (dmeyers@ieccode.com)

2018 International Energy Conservation Code
Revise as follows:

R402.4.1.2 (IRC N1102.4.1.2) Testing. The building or dwelling unit shall be tested and verified as having an air leakage rate not exceeding five air changes per hour in Climate Zones 1 and 2, and three air changes per hour in Climate Zones 3 through 8. Testing shall be conducted in accordance with RESNET/ICC 380, ASTM E 779 or ASTM E 1827 and reported at a pressure of 0.2 inch w.g. (50 Pascals). Where required by the code official, testing shall be conducted by an approved third party. A written report of the results of the test shall be signed by the party conducting the test and provided to the code official. Testing shall be performed at any time after creation of all penetrations of the building thermal envelope have been sealed.

Exception: For additions, alterations, renovations or repairs to existing buildings, building thermal envelope tightness and insulation installation shall be considered acceptable when the items in Table R402.4.1.1, applicable to the method of construction, are field verified. Where required by the code official, an approved third party independent from the installer shall inspect both air barrier and insulation installation criteria.

During testing:

1. Exterior windows and doors, fireplace and stove doors shall be closed, but not sealed, beyond the intended weatherstripping or other infiltration control measures.
2. Dampers including exhaust, intake, makeup air, backdraft and flue dampers shall be closed, but not sealed beyond intended infiltration control measures.
3. Interior doors, where installed at the time of the test, shall be open.
4. Exterior or interior terminations for continuous ventilation systems shall be sealed.
5. Heating and cooling systems, where installed at the time of the test, shall be turned off.
6. Supply and return registers, where installed at the time of the test, shall be fully open.

Reason: Should a bedroom addition to a farmhouse originally constructed in 1950’s rural America be required to be blower door tested to 3.0 ACH50? We think not. Accordingly, a reasonable middle ground is offered.

Cost Impact: The code change proposal will decrease the cost of construction
While interpreted literally, a blower door test is required for new construction, including additions.
RE102-19
IECC: R402.4.1.2.1 (IRC N1102.4.1.2.1) (New)

**Proponent:** Joel Martell, representing National Association of Home Builders (jmartell@nahb.org)

**2018 International Energy Conservation Code**

Add new text as follows:

R402.4.1.2.1 (IRC N1102.4.1.2.1) Multi-unit buildings and single family attached buildings shall be tested as a single zone, multiple zones, or as individual dwelling units in accordance with ASTM E779.

**Reason:** This proposal is very clear and straightforward, it helps to clarify testing in multi-unit buildings. The ASTM E779 standard is referenced in R402.4.1.2 and this standard allows for single, or multiple zone testing. This proposal is just adding clarification to the code for a method that is already allowed. Currently the IECC treats low-rise multifamily buildings of three stories or less like single-family homes and multifamily buildings of four stories or more like commercial buildings. Regardless of height, all multifamily buildings have the same airtightness testing complications to address. Large multiple dwelling buildings are often tested as isolated test zones due to the nature of the actual testing procedures and available equipment needed to depressurize large volumes of conditioned space and this proposal would recognize this challenge for those conducting the testing. By approving this proposal, low-rise multifamily buildings, two-unit dwellings and town houses will avoid these complications, but still be held to the same level of performance as high-rise (R-2) residential as well as commercial buildings.

**Cost Impact:** The code change proposal will not increase or decrease the cost of construction. This proposal will not change the cost of construction. It is adds clarification to something that is already allowed in the code.

Proposal # 4318

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**RE102-19**
RE103-19
IECC: R402.4.2 (New),

R402.4.6
(New)

Proponent: Marilyn Williams, representing NEMA

2018 International Energy Conservation Code

R402.4.2 Fireplaces. New wood-burning fireplaces shall have tight-fitting flue dampers or doors, and outdoor combustion air. Where using tight-fitting doors on factory-built fireplaces listed and labeled in accordance with UL 127, the doors shall be tested and listed for the fireplace.

Add new text as follows:

R402.4.6 Electrical and Communication Outlet Boxes (air-sealed boxes). Electrical and communication outlet boxes installed in the building thermal envelope shall be sealed to limit air leakage between conditioned and unconditioned spaces. Electrical and communication outlet boxes shall be tested in accordance with NEMA OS 4, Requirements for Air-Sealed Boxes for Electrical and Communication Applications, and shall have an air leakage rate of not greater than 2.0 cfm (0.944 L/s) at a pressure differential of 1.57 psf (75 Pa). Electrical and communication outlet boxes shall be marked "NEMA OS 4" or "OS 4" in accordance with NEMA OS 4. Electrical and communication outlet boxes shall be installed per the manufacturer's instructions and with any supplied components required to achieve compliance with NEMA OS 4.

Reason: Similar to Section R402.4.5 for recessed lighting a new section for electrical and communications outlet boxes is being proposed to limit air leakage when installed in the building thermal envelop. "Air-sealed boxes“ are identified in Table R402.4.1.1. This new section defines an air-sealed box.

Sealing air-barrier penetrations is not always as simple as applying more insulation, caulk, or expanding foam. Electrical and communication outlet boxes, having design features that effective seal the air-barrier penetrations, also reduce potentially undesirable effects that can result from the use of unspecified sealing techniques.

NEMA OS 4-2016, Requirements for Air-Sealed Boxes for Electrical and Communication Applications, was developed by the NEMA Outlet and Switch Box Section. In the preparation of NEMA OS 4, input of users and other interested parties was sought and evaluated.

Cost Impact: The code change proposal will not increase or decrease the cost of construction

An outlet box with an alternative means of sealing needs to be used if a vapor barrier box is not.

Proposal # 4077
RE104-19

IECC: R402.4.6 (IRC N1102.4.6) (New)

**Proponent:** donald sivigny, State of MN, representing State of MN and Association of Minnesota Building Officials (don.sivigny@state.mn.us)

**2018 International Energy Conservation Code**

Add new text as follows:

**R402.4.6 (IRC N1102.4.6) Replacement fenestration** Where a fenestration unit is replaced, the new unit shall meet the applicable requirements for U-factor and SHGC in Table R402.1.1.

**Reason:** When windows are replace, many times the replacement window is installed into the existing frame of the existing window. In such a case the existing window frame now becomes part of the wall assembly, and the new frame and window sash are considered a new fenestration product. In such cases this would require the new fenestration product (new frame, sash, glazing etc.) to meet the U-factor requirements of Table R402.1.2 or R402.1.4 of this code. If you are only replacing the glass or one portion of the window, this is not a replacement fenestration, it would then be a repair, and not a replacement.

**Cost Impact:** The code change proposal will increase the cost of construction. Although a replacement window that complies with the newest code will cost more than one than a replacement window that only complies with less stringent, older codes, the cost differential isn’t that significant as compared to the energy savings (pay-back) over the life of the up-to-current-code window.
RE105-19
IECC: R402.5 (IRC N1102.5)

Proponent: William Fay, Energy-Efficient Codes Coalition, representing Energy-Efficient Codes Coalition (bfay@ase.org); Daniel Bresette, Alliance to Save Energy, representing Alliance to Save Energy (dbresette@ase.org); Maureen Guttman, BCAP-IBTS, representing BCAP-IBTS (mguttman@bcapcodes.org); Harry Misuriello, American Council for an Energy-Efficient Economy, representing American Council for an Energy-Efficient Economy (misuriello@verizon.net)

2018 International Energy Conservation Code

Revise as follows:

R402.5 (IRC N1102.5) Maximum fenestration U-factor and SHGC (Mandatory). The area-weighted average maximum fenestration U-factor permitted using tradeoffs from Section R402.1.5 or R405 shall be 0.48 in Climate Zones 4 and 5 and 0.40 in Climate Zones 6 through 8 for vertical fenestration, and 0.75 in Climate Zones 4 through 8 for skylights. The area-weighted average maximum fenestration SHGC permitted using tradeoffs from Section R405 in Climate Zones 1 through 3 shall be 0.50.

Reason: The purpose of this code change proposal is to update the mandatory maximum fenestration U-factors and Solar Heat Gain Coefficients (SHGC) permitted in the IECC’s tradeoff compliance paths consistent with improvements in prescriptive fenestration values made since the maximums were originally included in the code. The fenestration maximums have been in the IECC since the 2006 IECC, and have provided a critical backstop in the event of trade-offs, helping to ensure reasonable energy efficiency and occupant comfort. Over the 12 years and 4 code update cycles that these backstops have been in place, prescriptive fenestration efficiencies have improved substantially, but the maximum U-factors and SHGCs have never been updated. To maintain the effectiveness of these backstops, we recommend that they be updated. The following graphs help to illustrate the growing “gap” between the prescriptive fenestration U-factors and the mandatory trade-off maximum in R402.5. The first graph below shows the improvements in U-factors for climate zones 4-5 over the last several code editions compared to the existing cap, and shows that there is still considerable trade-off flexibility if the trade-off maximum is improved from 0.48 to 0.40. (Note that the cap proposed above is the final data point.)

As shown in the second graph below, the U-factors in climate zones 6-8 follow a similar trend of improvement over the years, while the backstop remains at 0.40. Note that the impact of improving the maximum trade-off U-factor from 0.40 to 0.35 in climate zones 6-8 (as proposed) still leaves substantial trade-off room.
The effect is similar, but even more pronounced for SHGC. As shown in the SHGC graph below, the current SHGC maximum allows builders to essentially double the amount of heat gain (0.25 to 0.50) before hitting the current cap. Improving the SHGC trade-off maximum from 0.50 to 0.40 as we propose above still leaves more trade-off room than was available to builders in 2006 when the cap was originally instituted.

We believe that the improved fenestration maximums will be easily met. In fact, based on data recently collected by the U.S. Department of Energy across 8 states, we expect little or no change in homebuilding practices or any impact on homebuilding costs.

- In climate zones 1-3, of the 477 homes sampled, over 98% already complied with the proposed SHGC maximum of 0.40.
- Likewise, in climate zones 4-5, of the 468 homes sampled, over 98% already complied with the proposed U-factor maximum of 0.40.
- In climate zones 6-8, although DOE did not collect data for these climate zones as part of the Field Studies, the Energy Star program estimates that 83% of fenestration products shipped in 2016 met or exceeded Energy Star requirements (the Energy Star window criteria in 2016 was equal to or lower than a 0.30 U-factor in climate zones 6-8), which still leaves considerable trade-off room below a maximum U-factor of 0.35. See https://www.energystar.gov/ia/partners/downloads/unit_shipment_data/2016_USD_Summary_Report.pdf?8fd5-1967.

Anyone who has experienced inefficient uncomfortable windows, either during the winter or summer, understands that this discomfort can lead occupants to adjust the thermostat. The energy impact of adjusting the thermostat is large. The following table shows the increased energy use that results from adjusting the thermostat up or down a single degree in a code-compliant house in each climate zone:

<table>
<thead>
<tr>
<th>Measure</th>
<th>Weighted</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
</tr>
</thead>
<tbody>
<tr>
<td>+1 Degree Heating</td>
<td>4.1%</td>
<td>0.5%</td>
<td>3.0%</td>
<td>4.2%</td>
<td>4.4%</td>
<td>4.7%</td>
<td>4.5%</td>
<td>4.0%</td>
<td>2.9%</td>
</tr>
<tr>
<td>-1 Degree Cooling</td>
<td>3.0%</td>
<td>7.8%</td>
<td>5.3%</td>
<td>3.9%</td>
<td>2.6%</td>
<td>1.8%</td>
<td>1.4%</td>
<td>0.7%</td>
<td>0.4%</td>
</tr>
</tbody>
</table>

Obviously, if an uncomfortable occupant adjusts the thermostat 2 or 3 degrees, the impact will be far higher. Improved window maximums will reduce the likelihood of uncomfortable occupants using excessive heating and cooling to mitigate their discomfort.
We expect this to be an easy-to-implement improvement given the current state of practice, but an important update to the code, that will ensure long-term benefits for all homes with little or no additional cost.


**Cost Impact:** The code change proposal will not increase or decrease the cost of construction
Because this is only a change to a trade-off backstop and not a code requirement (the prescriptive requirement is already more efficient than the proposed new backstop level), and because such a high percentage of homebuilders are likely already meeting or exceeding this requirement, we expect no real cost impact in most cases.
Programmable thermostat. The thermostat controlling the primary heating or cooling system of the dwelling unit shall be capable of controlling the heating and cooling system on a daily schedule to maintain different temperature set points at different times of the day, providing a 5:2 (weekdays:weekends) programmable schedule, and at least 2 programmable schedules per day. This thermostat shall include the capability to set back or temporarily operate the system to maintain zone temperatures of not less than 55°F (13°C) to not greater than 85°F (29°C). The thermostat shall be programmed initially by the manufacturer with a heating temperature setpoint of not greater than 70°F (21°C) and a cooling temperature setpoint of not less than 76°F (24°C).

Reason: This code change clarifies the intended operational capability of programmable thermostats by distinguishing between weekday and weekend occupancy schedules along with at least 2 programmable schedules per day. The change also accounts for the capabilities of smart thermostatic controls that auto-adjust based on daily and weekly occupancy patterns. Finally, the manufacturer's initial programmed setting requirement is deleted.

This proposal is submitted by the ICC Sustainable, Energy and High Performance Code Action Committee (SEHPCAC). The SEHPCAC was established by the ICC Board of Directors to pursue opportunities to improve and enhance International Codes with regard to sustainability, energy and high performance as it relates to the built environment included, but not limited to, how these criteria relate to the International Green Construction Code (IgCC) and the International Energy Conservation Code (IECC). In 2018-2019, the SEHPCAC has held five two- or three-day open meetings and numerous workgroup calls, to discuss and debate proposed changes and public comments. Attendees at the meetings and calls included members of the SEHPCAC as well as any interested parties. Related documentation and reports are posted on the SEHPCAC website at: http://www.iccsafe.org/cs/SEHPCAC/Pages/default.aspx

Cost Impact: The code change proposal will increase the cost of construction. This requirement will increase costs for the subset of buildings not currently constructed with weekday:weekend programmable thermostats.
R403.1.3 (IRC N1103.1.3) Continuously Burning Pilot Lights. The natural gas systems and equipment listed below are not permitted to have continuously burning pilot lights:

1. Fan-type central furnaces.

**Exception:** Household cooking appliances without electrical supply voltage connections and in which each pilot light consumes less than 150 Btu/hr.

3. Pool heaters.
4. Spa heaters.
5. Fireplaces.

Revise as follows:

R403.10.1 (N1103.10.1) Heaters. The electric power to heaters shall be controlled by a readily accessible on-off switch that is an integral part of the heater mounted on the exterior of the heater, or external to and within 3 feet (914 mm) of the heater. Operation of such switch shall not change the setting of the heater thermostat. Such switches shall be in addition to a circuit breaker for the power to the heater. Gas-fired heaters shall not be equipped with continuously burning ignition pilots.

**Reason:** Standing pilot lights are no longer necessary with many gas-fired appliances offering alternative ignition methods. Some models rely completely on intermittent ignition, while others allow standing pilots to operate for a few hours after shutdown and then use electronic ignition to restart. This proposal saves energy by eliminating the wasted energy of a pilot light during the numerous hours per year when the appliance is non-operational.

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

This prohibition is not expected to add significant cost to any gas-fired appliance listed in the proposal. Past efficiency studies have shown $100 increase in price for fireplaces in particular to move from a standard continuously lit pilot light to an intermittent ignition system.
RE108-19
IECC: R403.2 (IRC N1103.2)

Proponent: Roger Mitchell, Mitchell's Heating and Cooling, representing Self (rogersheating@hotmail.com)

2018 International Energy Conservation Code
Revise as follows:

R403.2 (IRC N1103.2) Hot water boiler outdoor-temperature reset. Hot water boilers that supply heat to the building through one- or two-pipe heating systems shall have an outdoor setback control that decreases the boiler water temperature based on the outdoor temperature. The manufacturer shall equip each gas, oil and electric boiler (other than a boiler equipped with a tankless domestic water heating coil) with automatic means of adjusting the water temperature supplied by the boiler to ensure incremental change of the inferred heat load will cause an incremental change in the temperature of the water supplied by the boiler. This can be accomplished with outdoor reset, indoor reset or water temperature sensing.

Reason: The current standard from the DOE allows for a broader scope in control schemes to meet all the control strategies available in the marketplace. The exception for domestic hot water needs to be included to allow the sale of boilers with integrated domestic hot water production. Currently over 40,000 units are sold per year with domestic hot water coils. The standard from the DOE was updated after the Energy Independence act of 2007 with a implementation date of 2012. This change will bring the IECC code in uniformity with the DOE.

Cost Impact: The code change proposal will not increase or decrease the cost of construction. Alignment of the standard to the DOE standard will not increase costs because all of the Heating equipment being installed has the proper controls to meet the DOE standard. No additional components will be required if both standards are the same.
RE109-19

IECC: R403.3 (IRC N1103.3), R403.3.1 (IRC N1103.3.1), R403.3.7 (IRC N1103.3.7)

Proponent: Robby Schwarz, EnergyLogic, representing EnergyLogic (robb@nrglogic.com); Shaunna Mozingo (sdmozingo@shaunnamozingo.com)

2018 International Energy Conservation Code

Revise as follows:

R403.3 (IRC N1103.3) Ducts. Ducts and air handlers shall be installed in accordance with Sections R403.3.1 through R403.3.7 and R403.3.6.

R403.3.1 (IRC N1103.3.1) Insulation (Prescriptive). Supply and return ducts in attics shall be insulated to an R-value of not less than R-8 for ducts 3 inches (76 mm) in diameter and larger and not less than R-6 for ducts smaller than 3 inches (76 mm) in diameter. Supply and return ducts in other portions of the building shall be insulated to not less than R-6 for ducts 3 inches (76 mm) in diameter and not less than R-4.2 for ducts smaller than 3 inches (76 mm) in diameter.

Exception: Ducts or portions thereof located completely inside the building thermal envelope.

R403.3.6 (IRC N1103.3.6) R403.3.6 (IRC N1103.3.6) Ducts located in conditioned space, and insulation. Duct work located outside conditioned space, shall be insulated to an R-value of not less than R-8. For duct work to be considered as inside a conditioned space, such ducts shall comply with one of the following:

1. The duct system shall be located completely within the continuous air barrier and within the building thermal envelope.
2. The ducts shall be buried within ceiling insulation installation in accordance with Section R403.3.6 and all of the following conditions shall exist:
   2.1. The air handler is located completely within the continuous air barrier and within the building thermal envelope.
   2.2. The duct leakage, measured either by a rough-in test of the ducts or a post-construction total system leakage test to outside the building thermal envelope in accordance with Section R403.3.4, is less than or equal to 1.5 cubic feet per minute (42.5 L/min) per 100 square feet (9.29 m²) of conditioned floor area served by the duct system.
   2.3. The ceiling insulation R-value installed against and above the insulated duct is greater than or equal to the proposed ceiling insulation R-value, less the R-value of the insulation on the duct.
3. Duct work in floor cavities located over unconditioned space shall have a continuous air barrier on all six sides of the floor cavity and insulation installed in accordance with section R402.2.8 with the addition of insulation fully surrounding the duct and uncompressed R-19 insulation below, or duct work installed in a floor cavity that is insulated per the exception in section R402.2.8.
4. Duct work located within exterior walls shall have a continuous air barrier on all six sides of the wall cavity, a minimum R-10 insulation separating the entire duct from the outside sheathing of the cavity, and the remainder of the cavity insulation fully surrounding the duct to the drywall side.

Reason: Ductwork insulation is dependent on its location. This proposal addresses this issue. By removing Section R403.3.1 Insulation, and combining it with section R403.3.7 duct location, the code becomes more understandable and usable for field practitioners. This newly edited section requires that all duct work located outside of conditioned space regardless of size be insulated to an R-8. This minimum R-value duct insulation is widely available and important to have on ducts located outside regardless of the climate zone in which it is installed or the size of the duct. In addition, it is already the required R-value for duct work located outside per the existing section R403.3.1. As Allison Bailes points out in his Energy Vanguard blog post titled, “The invisible problem with duct insulation” The delta T across the insulated surface can be huge when ducts are located outside the conditioned space. In his example ducts located in the attic experienced a delta T of 62°. Although it would be good to raise the minimum required R-value associated with ducts located outside the conditioned envelope this proposal instead incentivizes installation techniques that drive the performance of the duct to be more like that of ducts installed completely inside.

By defining the three possible locations where ductwork can be installed and how to address the insulated assembly so the duct can be considered to be inside conditioned space this proposal increases the energy performance of homes. The three possible locations for duct installation are, one, completely inside the continuous air barrier assemblies, two, completely outside the continuous air barrier assemblies, or three within the continuous air barrier and building thermal envelope assemblies. In the last code cycle, the addition of section R403.3.6 Ducts buried within ceiling insulation addressed the insulation installation issue for ducts located outside of the continuous air barrier assemblies. This code cycle, the hope is that ducts located within the continuous air barrier and building thermal envelope assemblies will be addressed.

The last detail to point out is an energy code compliance issue when using section R405 Simulated Performance Alternative and section R406 Energy Rating Index compliance paths. These pathways include duct location in the software modeling. It has not been clear until the 2018 IECC how to model buried ductwork and the hope now is that the additional language in this proposal will clarify how to model duct work that is installed within the continuous air barrier and building thermal envelope assemblies. If it is installed per this code change proposal is can be considered to be within conditioned space.

See example diagrams for examples of how insulation of duct work installed within the building thermal envelope assembly could be achieved in
order to locate them within the conditioned space.

The following diagrams illustrate example installations of duct work in garage floor systems or in exterior walls that would be considered to be within the conditioned space.

Example of Ducts in Exterior walls that would be considered within the conditioned space

Duct chase on exterior wall - Solution 2

Duct chase on exterior wall - Solution 1

Duct riser in a 2x6 exterior wall

- Line of the interior air barrier now brings duct into conditioned space
- Foam board must be sealed in place at connections to wood framing. Foam board should be installed at the rim joist were the duct riser transitions to with an elbow to a boot or floor run.
- It is usual to splice to a 4” oval to accommodate the flow of a 4” round design run.
- Seal duct penetration through top and bottom plate

Blown Insulation filling the cavity around the duct

2" R-10 Foam board or closed cell Foam

Exterior sheathing
Supply Duct Riser in an Exterior Wall – Solution 3

For situations where a wall cannot be bumped out into the conditioned space of the home:

In a 2x6 wall cavity an oval duct should be installed to the inside of the framed cavity. 2 inches of foam board (minimum R-10 expanded polystyrene or R-14 polyisocyanurate) should be installed adjacent to the exterior sheathing and sealed to the side studs, top, and bottom plate of the cavity. This creates continuous insulation on the exterior side of the cavity, along with an interior and exterior air barrier which allows the duct to perform as if it has been installed completely inside the thermal envelope. The remaining space in the cavity must be blown with insulation encapsulating the duct except that edge that might be adjacent to the interior drywall. The duct must be air sealed with expanding foam where it penetrates the top and bottom plate.

Example of Duct in wall between house and garage

Seal duct to penetration through top and bottom plate
Blown insulation or two layers of R-15 batts:
1-cut around duct 2-continuous across garage side of cavity
Example of Duct in floor system that would be considered within the conditioned space.

Ductwork in floor over garage

- No minimum R-value requirement between ductwork and conditioned space
- Subfloor + wallboard encapsulate insulation
- Soffit is completely filled with blown insulation. Minimum R-19 insulation required below duct.
- Duct is located within the thermal boundary and considered to be inside conditioned space. Separate duct insulation sleeve not required.

NOTE: This approach is only approved if BLOWN insulation is used to completely fill the soffit.

3/19/2012

Ductwork in garage soffit, adjoining conditioned space, living space above - Solution 2

- "Wall" of soffit must be full of insulation, meet exterior wall R-value minimum.
- Interior sheathing and exterior wallboard fully encapsulate insulation.
- Duct is located inside the thermal boundary, in conditioned space. No insulation is required on the ductwork.

3/19/2012
Cost Impact: The code change proposal will not increase or decrease the cost of construction. This proposal provides new installation guidance and a definition of when a duct is considered to be inside conditioned space that will increase the energy efficiency of a house with better insulated ducts when installed within the continuous air barrier and building thermal envelope assemblies. Ductwork must be insulated and installed per manufacturer instruction. Also, insulation currently must fully surround obstructions like ductwork that is installed in a cavity. So, no additional cost should be expected with the approval of this proposal.
2018 International Energy Conservation Code

R403.3.2 (IRC N1103.3.2) Sealing (Mandatory). Ducts, air handlers and filter boxes shall be sealed. Joints and seams shall comply with either the International Mechanical Code or International Residential Code, as applicable.

Exception: Ducts or portions thereof located completely inside the building thermal envelope.

Reason: When ductwork is located inside a building's thermal envelope, any duct leakage from unsealed ductwork enters an already conditioned space within the building thermal envelope. Therefore, no energy loss occurs that is directly related to the sealed and/or unsealed air leakage through the building envelope and not by an unsealed duct in a conditioned space. Although sealing ductwork located inside the building's thermal envelope provides better comfort for the homeowner, it has no impact on energy efficiency or economic benefits. When discussing building energy efficiency and economic benefits, a homeowner should focus on reducing building leaks, better insulation, windows, and doors, as these are areas where building energy efficiency is lost at the building envelope, not by sealing ductwork in a conditioned space.

Cost Impact: The code change proposal will decrease the cost of construction. The proposal will potentially eliminate the need to seal ducts under the conditions specified in the exception, thus reducing the cost of construction in those situations.
2018 International Energy Conservation Code

Revise as follows:

R403.3 (IRC N1103.3) Ducts. Ducts and air handlers shall be installed in accordance with Sections R403.3.1 through R403.3.7.

R403.3.1 (IRC N1103.3.1) Insulation (Prescriptive). Ducts shall be insulated in accordance with Sections R403.3.1.1 or R403.3.1.2. Supply and return ducts in attics shall be insulated to an R-value of not less than R-8 for ducts 3 inches (76 mm) in diameter and larger and not less than R-6 for ducts smaller than 3 inches (76 mm) in diameter. Supply and return ducts in other portions of the building shall be insulated to not less than R-6 for ducts 3 inches (76 mm) in diameter and not less than R-4.2 for ducts smaller than 3 inches (76 mm) in diameter.

Exception: Ducts or portions thereof located completely inside the building thermal envelope.

Add new text as follows:

R403.3.1.1 (IRC N1103.3.1.1) Supply and return ducts not completely in thermal envelope (Mandatory). Ducts not completely inside the building thermal envelope shall be insulated to an R-value of not less than R-6.

R403.3.1.2 (IRC N1103.3.1.2) Supply and return ducts in the building (Prescriptive). Supply and return ducts partially or fully inside the building shall be insulated as follows:

1. Supply and return ducts in attics shall be insulated to an R-value of not less than R-8 for ducts 3 inches (76 mm) in diameter and larger and not less than R-6 for ducts smaller than 3 inches (76 mm) in diameter.
2. Supply and return ducts in other portions of the building shall be insulated to not less than R-6 for ducts 3 inches (76 mm) in diameter and not less than R-4.2 for ducts smaller than 3 inches (76 mm) in diameter.

Exception: Ducts or portions of ducts located completely inside the building thermal envelope in accordance with section R403.3.7.

Revise as follows:

R405.2 (IRC N1105.2) Mandatory requirements. Compliance with this section requires that the mandatory provisions identified in Section R401.2 be met. Supply and return ducts not completely inside the building thermal envelope shall be insulated to an R-value of not less than R-6.

R406.2 (IRC N1106.2) Mandatory requirements. Compliance with this section requires that the provisions identified in Sections R401 through R404 indicated as “Mandatory” and Section R403.5.3 be met. The building thermal envelope shall be greater than or equal to levels of efficiency and Solar Heat Gain Coefficients in Table 402.1.1 or 402.1.3 of the 2009 International Energy Conservation Code.

Exception: Supply and return ducts not completely inside the building thermal envelope shall be insulated to an R-value of not less than R-6.

Reason: This proposal consolidates all duct insulation requirements within one section.

The requirements for ducts not completely inside of the thermal envelope of the proposed R403.3.1.1 are currently identified as mandatory in both R405.2 and in R406.2, (in a confusing exception) and are labeled as such in this proposal.

The current Sec. R403.3.1 prescriptive insulation requirements for ducts partially or fully inside the building are separated into the proposed R403.3.1.2 (1) requirements for ducts in attics and R403.3.1.2 (2) ducts within other portions of the building.

The current exception to insulation requirements for ducts located completely inside the thermal envelope is maintained but a reference to the applicable section, R403.3.7, is provided for clarity.

Consolidation of requirements will make the code easier to use and enforce.

Note that companion proposals submitted by the SEHPCAC eliminate the use of the ‘mandatory’ (non-tradeable) and ‘prescriptive’ (tradeable) labels in favor of tabular identification of ‘mandatory’ sections. ICC staff have stated that if both proposals are approved the ‘mandatory’ label will be editorially deleted in favor of the new R405.2 and R406.2 tabular listings. Since all ‘mandatory’ sections would be identified in those new tables no sections will need to be separately identified as ‘prescriptive’ and those labels can also be removed.

This proposal is submitted by the ICC Sustainable, Energy and High Performance Code Action Committee (SEHPCAC). The SEHPCAC was established by the ICC Board of Directors to pursue opportunities to improve and enhance International Codes with regard to sustainability, energy and high performance as it relates to the built environment included, but not limited to, how these criteria relate to the International Green
Construction Code (IGCC) and the International Energy Conservation Code (IECC). In 2018-2019, the SEHPCAC has held five two- or three-day open meetings and numerous workgroup calls, to discuss and debate proposed changes and public comments. Attendees at the meetings and calls included members of the SEHPCAC as well as any interested parties. Related documentation and reports are posted on the SEHPCAC website at: http://www.iccsafe.org/cs/SEHPCAC/Pages/default.aspx

Cost Impact: The code change proposal will not increase or decrease the cost of construction. There is a reorganization of current provisions for greater clarify and enhanced enforcement. There are no proposed changes to the requirements.
2018 International Energy Conservation Code

R403.3 (IRC N1103.3) Ducts. Ducts and air handlers shall be installed in accordance with Sections R403.3.1 through R403.3.7.

R403.3.1 (IRC N1103.3.1) Insulation (Prescriptive). Supply and return ducts in attics shall be insulated to an $R$-value of not less than R-8 for ducts 3 inches (76 mm) in diameter and larger and not less than R-6 for ducts smaller than 3 inches (76 mm) in diameter. Supply and return ducts in other portions of the building shall be insulated to not less than R-6 for ducts 3 inches (76 mm) in diameter and not less than R-4.2 for ducts smaller than 3 inches (76 mm) in diameter.

Exception: Ducts or portions thereof located completely inside the building thermal envelope.

R403.3.2 (IRC N1103.3.2) Sealing (Mandatory). Ducts, air handlers and filter boxes shall be sealed. Joints and seams shall comply with either the International Mechanical Code or International Residential Code, as applicable.

R403.3.2.1 (IRC N1103.3.2.1) Sealed air handler. Air handlers shall have a manufacturer’s designation for an air leakage of not greater than 2 percent of the design airflow rate when tested in accordance with ASHRAE 193.

Revise as follows:

R403.3.3 (IRC N1103.3.3) Duct testing (Mandatory). Ducts shall be pressure tested to determine air leakage by one of the following methods:

1. Rough-in test: Total leakage shall be measured with a pressure differential of 0.1 inch w.g. (25 Pa) across the system, including the manufacturer’s air handler enclosure if installed at the time of the test. Registers shall be taped or otherwise sealed during the test.
2. Postconstruction test: Total leakage shall be measured with a pressure differential of 0.1 inch w.g. (25 Pa) across the entire system, including the manufacturer’s air handler enclosure. Registers shall be taped or otherwise sealed during the test.

Exceptions: A duct air-leakage test shall not be required where the ducts and air handlers are located entirely within the building thermal envelope.

A written report of the results of the test shall be signed by the party conducting the test and provided to the code official.

R403.3.4 (IRC N1103.3.4) Duct leakage (Prescriptive). The total leakage of the ducts, where measured in accordance with Section R403.3.3, shall be as follows:

1. Rough-in test: The total leakage shall be less than or equal to 4 cubic feet per minute (113.3 L/min) per 100 square feet (9.29 m$^2$) of conditioned floor area where the air handler is installed at the time of the test. Where the air handler is not installed at the time of the test, the total leakage shall be less than or equal to 3 cubic feet per minute (85 L/min) per 100 square feet (9.29 m$^2$) of conditioned floor area.
2. Postconstruction test: Total leakage shall be less than or equal to 4 cubic feet per minute (113.3 L/min) per 100 square feet (9.29 m$^2$) of conditioned floor area.
3. Test for ducts within thermal envelope: Where all ducts and air handlers are located entirely within the building thermal envelope, total leakage shall be less than or equal to 8.0 cubic feet per minute (226.6 L/min) per 100 square feet (9.29 m$^2$) of conditioned floor area.

Reason: The purpose of this code change proposal is to help ensure occupant comfort, proper heating and cooling system performance, and resulting long-term energy savings by requiring a duct leakage test for all new homes, including homes with all ducts inside conditioned space. This action will also help reduce the likelihood of builder callbacks for poorly-functioning, uncomfortable HVAC systems. The IECC currently exempts homes from duct testing requirements where the air handler and all ducts are located inside conditioned space. Although moving all ducts inside conditioned space may have a positive impact on energy efficiency overall, this practice alone cannot guarantee that the ducts will be tight enough to deliver conditioned air to all occupied areas of the home. Uncomfortable occupants commonly adjust thermostat settings to counteract the effect of poor delivery of conditioned air, leading to huge losses in energy efficiency. And these homes are at far greater risk for builder callback. This proposal will improve building quality and keep occupants more comfortable by requiring a duct test for all new homes, although the allowable...
leakage rate will be set at twice the prescriptive rate when all ducts are located inside conditioned space. Duct leakage rates can be extremely high when ducts are not tested. We do not believe that builders intentionally cut corners in duct sealing when they know that the system will not be tested. However, without an objective test as a means of quality assurance, even careful builders may not be aware of missed connections or poor sealing. In a recent DOE field study of residential homes in Kentucky, homes received duct leakage tests even where all supply and return ducts were located inside conditioned space. The results were striking – of the 24 homes tested (that would have qualified for the test exemption under the IECC), all 24 homes had higher leakage rates than the 2018 IECC requirement. Tested duct leakage for these homes averaged 18.5 cfm/sq.ft., with individual homes ranging from 6.26 cfm/sq.ft. to as high as 40.36 cfm/sq.ft. See https://www.energycodes.gov/compliance/energy-code-field-studies. We note that 40 other homes in the same study were required to be tested (because at least some ducts were located outside conditioned space), and these homes achieved leakage rates of 9.7 cfm/sq.ft., on average – roughly half the leakage rate of homes that qualified for the exemption. Obviously, this is a small sample size, but the Field Studies found similar results in Pennsylvania, where “exempt” homes (with all ducts inside conditioned space) averaged almost 31 cfm/sq.ft. leakage, while homes required to be tested averaged almost 18 cfm/sq.ft. leakage.

<table>
<thead>
<tr>
<th>Results of DOE Field Study Data Collection on Duct Tightness</th>
</tr>
</thead>
<tbody>
<tr>
<td># Samples</td>
</tr>
<tr>
<td>Max Test Result</td>
</tr>
<tr>
<td>Min Test Result</td>
</tr>
<tr>
<td>Avg Test Result</td>
</tr>
</tbody>
</table>

Although the results vary across the states sampled, these results point to a shortcoming in the IECC’s “complete exemption” approach to homes with all ducts inside conditioned space.

Although most energy modeling software does not capture the occupant-level impact of poorly-sealed ducts, anyone who has lived or worked in a building with leaky ducts understands that discomfort can lead occupants to adjust the thermostat. The energy impact of adjusting the thermostat is huge. The following table shows the increased energy use that results from adjusting the thermostat up or down a single degree in a code-compliant house in each climate zone.

<table>
<thead>
<tr>
<th>Increased Energy Use Resulting from Thermostat Adjustment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Measure</td>
</tr>
<tr>
<td>+1 Degree Heating</td>
</tr>
<tr>
<td>-1 Degree Cooling</td>
</tr>
</tbody>
</table>

Obviously, if an uncomfortable occupant adjusts the thermostat 2 or 3 degrees, the impact will be far higher, and could essentially negate many of the efficiency gains made in the IECC over the last decade.

The concept of requiring a test for all new homes is not new. DOE’s Building America Program recommends that “[e]ven in conditioned space, ducts should be insulated to reduce the risk of condensation and mold. They should be tightly sealed and tested for leakage.” See https://www.energy.gov/sites/prod/files/2014/01/f6/1_1g_ba_innov_ductsconditionedspace_011713.pdf. Likewise, the International Association of Certified Home Inspectors recommends that ducts be located entirely within conditioned space and tested to ensure air tightness. Air leakage rates at air handlers, even when all ducts are located in conditioned space, can lead to significant reduction in comfort, leading homeowners to adjust the thermostat and significantly increase energy use. See https://www.nachi.org/inspecting-hvac-cabinet-seams-air-leakage-sealing.htm.


Cost Impact: The code change proposal will increase the cost of construction This proposal will require duct testing and meeting a modest duct tightness level in the limited subset of homes that are currently exempt from the test requirement in the IECC. However, we believe the added value in quality control for builders and the likely positive impact on occupant comfort
and energy savings will easily outweigh the cost of the test and any remedial efforts to improve duct tightness.
2018 International Energy Conservation Code

Revise as follows:

**R403.3.3 (IRC N1103.3.3) Duct testing (Mandatory).** Ducts shall be pressure tested to determine air leakage by one of the following methods:

1. Rough-in test: Total leakage shall be measured with a pressure differential of 0.1 inch w.g. (25 Pa) across the system, including the manufacturer’s air handler enclosure if installed at the time of the test. Registers shall be taped or otherwise sealed during the test.
2. Postconstruction test: Total leakage shall be measured with a pressure differential of 0.1 inch w.g. (25 Pa) across the entire system, including the manufacturer’s air handler enclosure. Registers shall be taped or otherwise sealed during the test.

**Exceptions:**

1. A duct air-leakage test shall not be required where the ducts and air handlers are located entirely within the building thermal envelope.
2. A duct air-leakage test shall not be required for ducts serving heat or energy recovery ventilators that are not integrated with ducts serving heating or cooling systems.

A written report of the results of the test shall be signed by the approved third party conducting the test, that has been certified to perform duct testing by a national or state organization, and provided to the code official. The approved third party may not be employed or have any financial interest in the company constructing the building.

**Reason:** The International Residential Code (IRC) and International Energy Conservation Code (IECC) includes enhanced emphasis on envelope infiltration and duct leakage. Significant changes in the residential energy requirements include more frequent requirement of performance testing for leakage. Residential Duct systems must be tested unless all ducts and equipment are located within the conditioned space. Envelope testing is required to demonstrate compliance with maximum allowable leakage rate. This language puts the regulatory authority on notice that the testing requires specialized credentials and establishes a conflict of interest baseline.

**Cost Impact:** The code change proposal will not increase or decrease the cost of construction. This code proposal does not change the requirement for duct testing to be conducted and therefore should not increase or decrease the cost of construction. It does however change who conducts the test such that the installation contractor is not self-certifying compliance with Code. This change aligns section R403.3 for duct leakage testing with Section R402.4 Air Leakage such that both would require that testing be conducted by an approved third party.

Proposal # 4593
RE114-19
IECC: R403.3.3 (IRC N1103.3.3), Chapter 6RE (IRC Chapter 44) (New)

Proponent: Ryan Meres, RESNET, representing RESNET (ryan.meres@gmail.com)

2018 International Energy Conservation Code
Revise as follows:

R403.3.3 (IRC N1103.3.3) Duct testing (Mandatory). Ducts shall be pressure tested in accordance with ANSI/RESNET/ICC 380 or ASTM E1554 to determine air leakage by one of the following methods:

1. Rough-in test: Total leakage shall be measured with a pressure differential of 0.1 inch w.g. (25 Pa) across the system, including the manufacturer’s air handler enclosure if installed at the time of the test. Registers shall be taped or otherwise sealed during the test.
2. Postconstruction test: Total leakage shall be measured with a pressure differential of 0.1 inch w.g. (25 Pa) across the entire system, including the manufacturer’s air handler enclosure. Registers shall be taped or otherwise sealed during the test.

Exceptions:

1. A duct air-leakage test shall not be required where the ducts and air handlers are located entirely within the building thermal envelope.
2. A duct air-leakage test shall not be required for ducts serving heat or energy recovery ventilators that are not integrated with ducts serving heating or cooling systems.

A written report of the results of the test shall be signed by the party conducting the test and provided to the code official.

Add new text as follows:

ASTM
ASTM International
100 Barr Harbor Drive, P.O. Box C700
West Conshohocken PA 19428-2959

E1554/E1554M-13:
Standard Test Methods for Determining Air Leakage of Air Distribution Systems by Fan Pressurization

Reason: Section 403.3.3, Duct testing, currently provides no guidance for testing duct systems to determine if they meet the maximum duct leakage rate. The current code language sets a duct leakage metric and essentially leaves it up to those that are testing the system to determine how to arrive at the results. The lack of guidance can lead to inconsistent test results from house to house. This code change proposal solves this problem by requiring testing to conform to ANSI/RESNET/ICC Standard 380 - Standard for Testing Airtightness of Building Enclosures, Airtightness of Heating and Cooling Air Distribution Systems, and Airflow of Mechanical Ventilation Systems OR ASTM E1554. Standard 380 provides a standardized methodology that is currently in use throughout the industry. The methodology will provide consistent results that can be replicated by testing organizations and enforcement personnel.

RESNET/ICC Standard 380 has been developed to provide a consensus national standard for consistent measurement of several air-flow related residential building metrics. It builds off of existing American National Standards to provide standard procedures essential to the evaluation of the energy performance of residential buildings energy.

ASTM Standard E1554-13, was most recently re-approved in 2018 and describes 4 different test methods (A, B, C, and D) for performing a duct leakage test. Method A requires multi-point testing of both the enclosure and the distribution system at a range of 5 to 50 Pa in 5 Pa increments using both pressurization AND depressurization of the building enclosure AND distribution system. Method B requires a physical separation of the supply and return distribution systems and that each are tested separately at a 25 Pa pressure difference, while measuring the pressure difference between any buffer zones and the outside. This procedure requires several iterations of each test (supply, return, buffer zone). Method C measures distribution system leakage to the outside using a 25 Pa pressure difference across the building enclosure with reference to the outside using a location sheltered from wind and sunshine. The distribution system is tested at a 25 Pa pressure difference with reference to the outside and the recording of inside temperature, outside temperature, and barometric pressure at the start and end of each test. This method requires testing under pressurization, while Standard 380 allows pressurization or depressurization (field conditions may require depressurization in order to maintain seals on the supply outlets and return inlets). Method D measures total distribution system leakage at a 25 Pa pressure difference with reference to the outside without using a fan (blower door) to create a 25 Pa pressure difference across the building enclosure to isolate leakage to the outside.

Although Standard 380 is a more industry-recognized standard, either Standard 308 or ASTM E1554 provide a consistent methodology for testing the air leakage of duct systems.

Cost Impact: The code change proposal will not increase or decrease the cost of construction.

ICC COMMITTEE ACTION HEARINGS :: April, 2019

RE208
The protocol for duct testing described in Standard 380 is consistent with the testing protocols presented in RESNET certifications for HERS raters and also with the Duct and Envelope Testing (DET) training sessions that are being deployed in several states to meet the testing needs of the IECC. This protocol is considered industry standard and will not increase the time for testing ductwork, so the cost of testing will not increase, but will lead to more compliant duct systems for duct testing professionals that may not be following a protocol. The protocol does not change the target duct air leakage rate so there are no additional costs to seal the duct system to make it code compliant. ASTM E1554 is offered as an alternative because it is another standard for testing duct systems for leakage.

**Analysis:** A review of the standard proposed for inclusion in the code, ASTM E1554/E1554M-2013, with regard to the ICC criteria for referenced standards (Section 3.6 of CP#28) will be posted on the ICC website on or before April 2, 2019.
RE115-19

IECC: R403.3.3 (IRC N1103.3), R403.3.4 (IRC N1103.3.4)

Proponent: William Fay, Energy-Efficient Codes Coalition, representing Energy-Efficient Codes Coalition (bfay@ase.org); Daniel Bresette, Alliance to Save Energy, representing Alliance to Save Energy (dbresette@ase.org); Maureen Guttman, BCAP-IBTS, representing BCAP-IBTS (mguttman@bcapcodes.org); Harry Misuriello, American Council for an Energy-Efficient Economy, representing American Council for an Energy-Efficient Economy (misuriello@verizon.net)

2018 International Energy Conservation Code

R403.3 Ducts. Ducts and air handlers shall be installed in accordance with Sections R403.3.1 through R403.3.7.

R403.3.1 Insulation (Prescriptive). Supply and return ducts in attics shall be insulated to an \( R \)-value of not less than R-8 for ducts 3 inches (76 mm) in diameter and larger and not less than R-6 for ducts smaller than 3 inches (76 mm) in diameter. Supply and return ducts in other portions of the building shall be insulated to not less than R-6 for ducts 3 inches (76 mm) in diameter and not less than R-4.2 for ducts smaller than 3 inches (76 mm) in diameter.

Exception: Ducts or portions thereof located completely inside the building thermal envelope.

R403.3.2 Sealing (Mandatory). Ducts, air handlers and filter boxes shall be sealed. Joints and seams shall comply with either the International Mechanical Code or International Residential Code, as applicable.

R403.3.2.1 Sealed air handler. Air handlers shall have a manufacturer’s designation for an air leakage of not greater than 2 percent of the design airflow rate when tested in accordance with ASHRAE 193.

Revise as follows:

R403.3.3 (IRC N1103.3) Duct testing (Mandatory). The ductwork in a building or dwelling unit shall be pressure tested to determine for air leakage. The maximum total leakage rate for ducts in any building or dwelling unit under any compliance path shall not exceed 8.0 cfm (226.5 L/min) per 100 square feet (9.29 m²) of conditioned floor area. Testing shall be conducted at the rough-in stage or post-construction by one of the following methods:

1. Rough-in test: Total leakage shall be measured with a pressure differential of 0.1 inch w.g. (25 Pa) across the system, including the manufacturer’s air handler enclosure if installed at the time of the test. Registers shall be taped or otherwise sealed during the test.
2. Postconstruction test: Total leakage shall be measured with a pressure differential of 0.1 inch w.g. (25 Pa) across the entire system, including the manufacturer’s air handler enclosure. Registers shall be taped or otherwise sealed during the test.

Exceptions:

1. A duct air-leakage test shall not be required where the ducts and air handlers are located entirely within the building thermal envelope.
2. A duct air-leakage test shall not be required for ducts serving heat or energy recovery ventilators that are not integrated with ducts serving heating or cooling systems.

A written report of the results of the test shall be signed by the party conducting the test and provided to the code official.

R403.3.4 (IRC N1103.3.4) Duct leakage (Prescriptive). The total leakage of the ducts, where measured in accordance with Section R403.3.3, shall be as follows:

1. Rough-in test: The total leakage shall be less than or equal to 4.0 cubic feet per minute (113.3 L/min) per 100 square feet (9.29 m²) of conditioned floor area where the air handler is installed at the time of the test. Where the air handler is not installed at the time of the test, the total leakage shall be less than or equal to 3.0 cubic feet per minute (85 L/min) per 100 square feet (9.29 m²) of conditioned floor area.
2. Postconstruction test: Total leakage shall be less than or equal to 4.0 cubic feet per minute (113.3 L/min) per 100 square feet (9.29 m²) of conditioned floor area.

Reason: The purpose of this code change proposal is to help ensure long-term energy savings, occupant comfort and promote good building quality by establishing a maximum level of duct leakage permitted as a trade-off backstop for duct tightness. We propose a backstop that would still permit substantial flexibility – double the allowable leakage rate as the prescriptive requirement -- but that would establish a “worst case scenario” for all tested homes in all compliance paths. There is currently no upper limit on duct leakage in the IECC. In the 2012 IECC, all ducts (except those in conditioned space) were required on a mandatory basis to meet the prescriptive levels. The mandatory nature of the requirement was removed in 2015, allowing duct tightness to be fully traded off for other efficiency measures. We believe some trade-off is acceptable, but that a minimum level of duct tightness is necessary to ensure some reasonable level of duct performance occurs in the home. When ducts are excessively leaky, there is no assurance that conditioned air is...
provided where it is needed for adequate comfort. The failure to properly distribute conditioned air is likely to result in excess energy usage when the occupants adjust the thermostat to counter an inadequate distribution of conditioned air. Many of the intended benefits of high-performance homes are negated if occupants are uncomfortable and adjust the thermostat in response.

**Cost Impact:** The code change proposal will not increase or decrease the cost of construction

The proposal is intended to be cost-neutral, since it does not change the prescriptive requirement, but will ensure that at least some reasonable attention has been paid to duct tightness. Because the new backstop will only apply in homes that are already required to have ducts tested, the only potential cost would come in a situation where a builder has traded away the efficiency of the duct system for an improvement elsewhere in the home at a lower cost such that the home would not even meet the weaker duct tightness level proposed here. However, in such cases, we believe owners and occupants of homes will benefit substantially from having an outer limit on duct leakage.
2018 International Energy Conservation Code

SECTION R403 (IRC N1103)
SYSTEMS

R403.3.3 (IRC N1103.3.3) Duct testing (Mandatory). Ducts shall be pressure tested to determine both total duct leakage and leakage to the outdoors, air leakage by one of the following methods:

1. Rough-in test: Total leakage shall be measured with a pressure differential of 0.1 inch w.g. (25 Pa) across the system, including the manufacturer's air handler enclosure if installed at the time of the test. Registers shall be taped or otherwise sealed during the test.
2. Postconstruction test: Total leakage shall be measured with a pressure differential of 0.1 inch w.g. (25 Pa) across the entire system, including the manufacturer's air handler enclosure. Registers shall be taped or otherwise sealed during the test.

Exceptions:

1. A duct air-leakage test shall not be required where the ducts and air handlers are located entirely within the building thermal envelope.
2. A duct air-leakage test shall not be required for ducts serving heat or energy recovery ventilators that are not integrated with ducts serving heating or cooling systems. A written report of the results of the test shall be signed by the party conducting the test and provided to the code official.

Add new text as follows:

R403.3.3.1 (IRC N1103.3.3.1) Total duct leakage rough-in test or post construction test: The total leakage shall be less than or equal to 4 cubic feet per minute (113.3 L/min) per 100 square feet (9.29 m²) of conditioned floor area served, (4cfm/100sqft), when the air handler is installed at the time of the test. When the air handler is not installed at the time of the test, the total leakage shall be less than or equal to 3 cubic feet per minute (85 L/min) per 100 square feet (9.29 m²) of conditioned floor area; (3cfm/100sqft). Registers shall be taped or otherwise sealed during the test.

Exceptions:

1. If the HVAC duct work system is serving less than 1500 square feet of conditioned floor area, the allowable total duct leakage target shall be 60 cfm regardless of the calculated 4 cfm/100 sqft minimum performance target.
2. A total duct leakage measurement of 80 cfm or less may replace the requirement to test for duct leakage to outside the building’s thermal envelope (R403.3.3.2) if compliance can be obtained through the modeling software calculations used to verify compliance with Section R405 or Section R406 for duct leakage to outside penalty or tradeoff.

R403.3.3.2 (IRC N1103.3.3.2) Duct leakage to outside the building's thermal envelope post construction test. Leakage to outside the building's thermal envelope shall be less than or equal to 4 cubic feet minute (113.3 L/min) per 100 square feet (9.29 m²) of conditioned floor area served, (4cfm/100sqft), when tested at a pressure differential of 0.1 inch w.g. (25 Pa) across the entire system, including the manufacturer's air handler enclosure, with a blower door and duct leakage testing device. Registers shall be taped or otherwise sealed during the test.

Exceptions:

1. A duct leakage to outside test shall not be required where the ducts and air handlers are documented, at a rough stage of construction, to be located entirely within the building's air barrier and thermal envelope. For systems that are not tested, a distribution systems efficiency of (0.96) for leakage to outside shall be permitted to be used when modeling for confirmed compliance with Sections R405 and R406.
2. If the HVAC duct work system is serving less than 1500 square feet of conditioned floor area the allowable duct leakage to outside shall be 60 CFM or less.

Revise as follows:

R403.3.4 (IRC N1103.3.4) Duct leakage (Prescriptive). The total leakage of the ducts, where measured in accordance with Section R403.3.3, shall be as follows:
1. **Rough-in test:** The total leakage shall be less than or equal to 4 cubic feet per minute (113.3 L/min) per 100 square feet (9.29 m²) of conditioned floor area where the air handler is installed at the time of the test. Where the air handler is not installed at the time of the test, the total leakage shall be less than or equal to 3 cubic feet per minute (85 L/min) per 100 square feet (9.29 m²) of conditioned floor area.

2. **Postconstruction test:** Total leakage shall be less than or equal to 4 cubic feet per minute (113.3 L/min) per 100 square feet (9.29 m²) of conditioned floor area.

**Reason:**
- Although requiring two duct leakage tests, this proposal actually focuses on total duct leakage. If the total HVAC duct system is tight the built-in exceptions would allow the system not to have to have the second duct leakage to outside test. In addition, if the duct can be verified to be within the Building’s Thermal Envelope and continuous air barrier assembly the duct would not have to be tested and could you a default distribution system efficiency. In this way great flexibility has been incorporated into this proposal.
- Currently having both mandatory and prescriptive requirements is confusing. Duct leakage testing is needed and needs to just be required to ensure efficiency, durability, safety, and comfort. Just as it is impossible to visually verify if a home’s air barrier system is air tight it is impossible to know if the duct system is tight unless it is tested.
- Both of the current testing paths, prescriptive and mandatory, use the wrong matrix from an energy perspective. In order to ensure the intent of the IECC is maintained regardless of the compliance path, it makes sense to keep the total duct leakage requirement as it deals with the efficiency of the HVAC system from a use perspective. If the master bedroom, for example, is not receiving the quantity of air required by the HVAC design due to leaky ducts, then the thermostat will be adjusted and inefficiencies will be created.
- Adding a Duct leakage to outside (LTO) testing requirement specifically addresses the energy lose component of duct leakage which is also the intent of the IECC. Since duct leakage is associated with two distinct means of inefficiencies, behavior and measured, both tests should be required.
- The 4 cfm/100sqft of floor area target currently penalizes small units, so we have introduced a fix that was first developed by the Energy Star program. Currently the total duct leakage target is based on the amount of conditioned floor area. In this proposal a ‘floor’ has been added to the duct leakage target for small homes. By ‘floor’, we mean a lower limit that doesn’t decrease as the space gets smaller and smaller.
- Energy Stars target floor is 40 CFM. We have used 80 CFM as it is a more reasonable target for small systems in our current state of installation and sealing expertise. In addition, it is our experience that there is a minimal modeling penalty associated with 80 CFM of duct leakage to outside.

**Bibliography:** Energy Conservatory

Duct Leakage to Outside Testing Instructions

http://energyconservatory.com

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

Currently Total duct leakage testing is required. Duct leakage to outside is also required for IECC code sections R405 simulated performance and R406 ERI pathways. Duct leakage to outside is a tradable feature and is an input in the modeling software used to demonstrate compliance with the code when using sections R405 and R406. Therefore, the code in essence is currently requiring both tests when these compliance options are used. **Price would increase for those who are using the prescriptive path** but should remain the same for those using the simulated performance path or the ERI path for compliance.
2018 International Energy Conservation Code

Revise as follows:

SECTION R403 (IRC N1103) SYSTEMS

R403.3.3 (IRC N1103.3.3) Duct testing (Mandatory). Ducts shall be pressure tested to determine air leakage by one of the following methods and shall not leak more than 4 cubic feet per minute (113.3 L/min) per 100 square feet (9.29 m²) of conditioned floor area served, (4cfm/100sqft), when the air handler is installed at the time of the test. When the air handler is not installed at the time of the test, the total leakage shall be less than or equal to 3 cubic feet per minute (85 L/min) per 100 square feet (9.29 m²) of conditioned floor area; (3cfm/100sqft). Registers shall be taped or otherwise sealed during the test.

1. Rough-in test: Total leakage shall be measured with a pressure differential of 0.1 inch w.g. (25 Pa) across the system, including the manufacturer’s air handler enclosure if installed at the time of the test. Registers shall be taped or otherwise sealed during the test.

2. Postconstruction test: Total leakage shall be measured with a pressure differential of 0.1 inch w.g. (25 Pa) across the entire system, including the manufacturer’s air handler enclosure. Registers shall be taped or otherwise sealed during the test.

Exceptions:

1. A duct air-leakage test shall not be required where the ducts and air handlers are located entirely within the building thermal envelope.

2. A duct air-leakage test shall not be required for ducts serving heat or energy recovery ventilators that are not integrated with ducts serving heating or cooling systems.

2. If the HVAC duct system is serving less than or equal to 1,500 square feet of conditioned floor area, the allowable duct leakage shall be 60 cubic feet per minute or less.

A written report of the results of the test shall be signed by the party conducting the test and provided to the code official.

Delete without substitution:

R403.3.4 Duct leakage (Prescriptive). The total leakage of the ducts, where measured in accordance with Section R403.3.3, shall be as follows:

1. Rough-in test: The total leakage shall be less than or equal to 4 cubic feet per minute (113.3 L/min) per 100 square feet (9.29 m²) of conditioned floor area where the air handler is installed at the time of the test. Where the air handler is not installed at the time of the test, the total leakage shall be less than or equal to 3 cubic feet per minute (85 L/min) per 100 square feet (9.29 m²) of conditioned floor area.

2. Postconstruction test: Total leakage shall be less than or equal to 4 cubic feet per minute (113.3 L/min) per 100 square feet (9.29 m²) of conditioned floor area.

Reason: Since the 2006 IECC it has been a mandatory requirement to seal ductwork. The language has changed very little and in Section R403.3.2 of the 2018 IECC it now says, “Ducts, air handlers and filter boxes shall be sealed. Joints and seams shall comply with either the International Mechanical Code or International Residential Code, as applicable.” A separate section is addressing building cavities by stating that, “Building framing cavities shall not be used as ducts or plenums” in order to ensure tight, efficient, and well performing HVAC systems. This short historical perspective reminds us that duct leakage has been an important energy conservation issue for quite some time; at least since 2006. However, it was not until the 2009 IECC that mandatory duct leakage testing entered the code. From that point forward the importance of duct leakage on the efficiency and performance of the house has not change, but more and more confusion has been introduced into the code. Currently, this confusion shows itself primarily in the relationship between testing organizations, HVAC contractors and builders, because there is a requirement to test, but there is no testing threshold target for the performance paths by which to hold a system to. Therefore, when using the performance paths, one mistakenly believes that yes, a system must be tested, but no it does not have to be tight. This inconsistency between section R403.3.2 Sealing and R403.3.3 Duct testing is at the heart of this code change.

The 4 CFM/100 square feet of conditioned floor area leakage threshold is currently only a prescriptive threshold target. This makes some sense as duct leakage is a tradable performance metric in the software tools used to demonstrate compliance using sections R405 and R406. However, it also makes no sense as the IECC currently requires a total duct leakage test while sections R405 and R406 require a duct leakage to outside test to assess the performance trade off. To add to the confusion, a field testing organization cannot report to the HVAC contractor and builder if a home has passed the duct leakage testing requirements of the code when using performance compliance options because the software tools must be fully
populated with data that is observed at both rough and final stages of construction in order to accurately determine tradeoffs.

This code change proposal simplifies the requirement and enforcement of the requirement. Just as whole house air leakage testing has specific blower door threshold targets, creating one minimum and specific threshold target for duct leakage allows for better and more streamline code adoption and enforcement. From a prescriptive compliance perspective, we know that if the home is equal to or better than the air leakage and duct leakage performance thresholds it is meeting the minimum efficiency requirements of the code. From a performance perspective we also need to know if the home is meeting the minimum threshold requirements and then additional compliance flexibility is achieved when or if the home performs better. The unintended consequence of introducing a mandatory and prescriptive duct leakage test has only led to mass confusion in the field and a miss interpretation of the requirements.

I believe that the intent of the current 2018 IECC is that the duct leakage testing threshold is the 4% target. However, interpretation abounds. If this proposal is adopted, testing organizations would be able to quickly determine if the home is passing or failing with out argument that tighter systems are not required. Field interpretation from the HVAC contractor and builder side has not been that a specific leakage threshold target must be achieved or that the system must be sealed as Section R403.3.2 Sealing (Mandatory) requires. Instead the field interpretation is often that the system must be tested, but can be extremely leaky. This code change proposal fixes this miss interpretation.

This proposal continues by requiring that the HVAC duct system be tested to a specific minimum target threshold regardless of the location of the duct work. There are two reasons for this change. First, a significant amount of energy savings is achieved when the total leakage of the system is reduced. Remember that the code is currently only testing for total leakage, but only on HVAC systems that have a portion of the duct located outside of the building thermal envelope. When HVAC duct systems are located within the building's thermal envelope, we are seeing significant total duct leakage that far exceed the 4 CFM/100 square feet of conditioned floor area threshold target, yet the system is in compliance with the code.

BTU's being delivered inside the building's thermal envelop does not equate to a home that is comfortable and efficient unless the correct quantity of BTU's that were designed to be delivered to the specific location occurs. Significant total duct leakage within the thermal envelop by definition ensures that the designed BTU's are not being delivered to their design location therefore causing comfort and efficiency issues. The occupant adjusts the thermostat in an attempt to deliver the required BTU's to the location where they are needed thus casing the system to run more often and less efficiently. The popularity of AreoSeal duct sealing in existing homes is a direct indication of this problem as homeowners seek a solution to leaky inefficient duct work that should have been addressed during construction.

https://aeroseal.com/

https://aeroseal.com/residential/how-aeroseal-works/

https://www.youtube.com/watch?v=06DlipDW0GU

The second reason to require duct leakage testing regardless of where the duct is located is due to cost saving that can be achieved. By just requiring the test to be performed, there will be a move to testing systems at a rough stage of construction to ensure that system testing failures do not impact construction cycle time or the closing of the home. This is the correct stage of construction for conducting the test, as if needed, the system can be economically fixed and retested before drywall has been installed.

Lastly, by holding duct systems to a 4 CFM/100 square feet of conditioned floor area threshold target the likely hood of needing a second test for duct leakage to outside when using R405 and R406 compliance options is low. Total duct leakage numbers in the 4% range can most often be used in software modeling to replace the duct leakage to outside number to demonstrate compliance when duct leakage to outside has not been tested. In other words the HVAC duct system will not leak more to outside than represented by the total duct leakage tested number, so if that number is used to represent duct leakage to outside and the home passes the compliance metrics of sections R405 or R406 then all is good and the home meets the intent of the code.

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

There will be a small cost impact because all duct systems will be required to be tested. However, regardless of where the ducts are located the IECC already requires that the system be sealed in section R403.3.2. It is not possible to visually verify if the duct system is tight just as it is not possible to visually see if a house is air tight, so testing should be required. Energy savings beyond the actual loss of BTU's to the outside will be achievable, but this will require builders and or HVAC contractors to pay testing organizations or third party approved agencies to verify the duct leakage of the system.
IECC: R403.3.3 (IRC N1103.3.3)

**Proponent:** Mike Moore, Newport Ventures, representing Broan-NuTone (mmoore@newportventures.net)

**2018 International Energy Conservation Code**

Revise as follows:

R403.3.3 (IRC N1103.3.3) Duct testing (Mandatory). Ducts shall be pressure tested to determine air leakage by one of the following methods:

1. Rough-in test: Total leakage shall be measured with a pressure differential of 0.1 inch w.g. (25 Pa) across the system, including the manufacturer’s air handler enclosure if installed at the time of the test. Registers shall be taped or otherwise sealed during the test.

2. Postconstruction test: Total leakage shall be measured with a pressure differential of 0.1 inch w.g. (25 Pa) across the entire system, including the manufacturer’s air handler enclosure. Registers shall be taped or otherwise sealed during the test.

**Exceptions:**

1. A duct air-leakage test shall not be required where the ducts and air handlers are located entirely within the building thermal envelope.

2. A duct air-leakage test shall not be required for ducts serving heat or energy recovery ventilators-ventilation systems that are not integrated with ducts serving heating or cooling systems.

A written report of the results of the test shall be signed by the party conducting the test and provided to the code official.

**Reason:** Regardless of the ventilation system type specified, this section is not meant to verify leakage associated with ventilation systems (exhaust, supply, or balanced/HRV/ERV) that are separate from the ducts serving heating or cooling systems.

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

This proposal will remove duct leakage verification testing that would otherwise unintentionally be applied to ventilation systems.
RE119-19

IECC: R403.3.3 (IRC N1103.3.4), R403.3.3 (IRC N1103.3.4)

Proponent: Joel Martell, representing National Association of Home Builders (jmartell@nahb.org)

2018 International Energy Conservation Code
Revise as follows:

R403.3.3 (IRC N1103.3.3) Duct testing (Mandatory). Ducts shall be pressure tested to determine air leakage by one of the following methods:

1. Rough-in test: Total leakage shall be measured with a pressure differential of 0.1 inch w.g. (25 Pa) across the system, including the manufacturer’s air handler enclosure if installed at the time of the test. Registers shall be taped or otherwise sealed during the test.

2. Postconstruction test: Total leakage shall be measured with a pressure differential of 0.1 inch w.g. (25 Pa) across the entire system, including the manufacturer’s air handler enclosure. Alternatively, a duct leakage test to outside conditioned space with a pressure differential of 0.1 w.g. (25 Pa) with reference to the outside across the entire system including the manufacturer’s air handler enclosure. Registers shall be taped or otherwise sealed during the test.

Exceptions:

1. A duct air-leakage test shall not be required where the ducts and air handlers are located entirely within the building thermal envelope.

2. A duct air-leakage test shall not be required for ducts serving heat or energy recovery ventilators that are not integrated with ducts serving heating or cooling systems.

A written report of the results of the test shall be signed by the party conducting the test and provided to the code official.

R403.3.4 (IRC N1103.3.4) Duct leakage (Prescriptive). The total leakage of the ducts, where measured in accordance with Section R403.3.3, shall be as follows:

1. Rough-in test: The total leakage shall be less than or equal to 4 cubic feet per minute (113.3 L/min) per 100 square feet (9.29 m²) of conditioned floor area where the air handler is installed at the time of the test. Where the air handler is not installed at the time of the test, the total leakage shall be less than or equal to 3 cubic feet per minute (85 L/min) per 100 square feet (9.29 m²) of conditioned floor area.

2. Postconstruction test: Total leakage or leakage to outside conditioned space shall be less than or equal to 1 cubic feet per minute (28.3 L/min) per 100 square feet (9.29 m²) of conditioned floor area.

Reason: Allowing the option for measurement of duct leakage to the outside will give both HVAC installers and homeowners an accurate measurement of duct leaks to the exterior of the building. This is the only true testing method that measures energy loss as the method is measuring the leakage outside the thermal envelope not from inside conditioned space. Duct leakage to the outdoors is an accepted duct testing method in the industry and was allowed under Section 403.2.2 of the 2009 IECC and approved for the 2015 IECC by the committee, but withdrawn by the proponent. Proposed changes provide clarity as to what distribution system efficiency should be applied to the Standard Reference Design and how the ducts should be modeled in the performance path.

Cost Impact: The code change proposal will not increase or decrease the cost of construction. This proposal will not change the cost of construction. It will provide a testing method that measures the true energy loss of ducts.

Proposal # 4293
**2018 International Energy Conservation Code**

Revised as follows:

**R403.3.4 (IRC N1103.3.4) Duct leakage (Prescriptive).** The total leakage of the ducts, where measured in accordance with Section R403.3.3, shall be as follows:

1. **Rough-in test:** The total leakage shall be less than or equal to 4.0 cubic feet per minute (113.3 L/min) per 100 square feet (9.29 m²) of conditioned floor area where the air handler is installed at the time of the test. Where the air handler is not installed at the time of the test, the total leakage shall be less than or equal to 3.0 cubic feet per minute (85 L/min) per 100 square feet (9.29 m²) of conditioned floor area.

2. **Postconstruction test:** Total leakage shall be less than or equal to 4.0 cubic feet per minute (113.3 L/min) per 100 square feet (9.29 m²) of conditioned floor area.

**Reason:** The purpose of this code change proposal is to clarify the current requirements for maximum duct leakage that are already part of the IECC and to ensure that buildings achieve the efficiency intended by the code by adding an additional digit. Specifically, the code proposal adds ".0" to the specified duct leakage rate to clarify that a value above 4.0 cfm (or 3.0 cfm where the air handler is not installed) is not allowed. While we believe that the best interpretation of the current standard is that the duct leakage may not exceed 4.0, the addition of another digit will preempt any claim that a tested value above these maximums, such as 4.4, will meet the maximum. By preempting these "round off" arguments from code users, this change will provide additional support for building code officials who are simply trying to enforce the code. This proposed clarification will not change any substantive requirements of the code but will improve compliance and enforcement and eliminate any confusion.

**Cost Impact:** The code change proposal will not increase or decrease the cost of construction. It merely serves to clarify a current requirement to avoid confusion and inconsistent enforcement.

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**Proposal # 3995**

RE120-19
2018 International Energy Conservation Code

Add new text as follows:

R403.3.4.1 (IRC N1103.3.4.1) Sampling options for R2 multifamily dwelling units. For buildings having three or more dwelling units, a minimum of 15% of the dwelling units in each building must be tested as required by Section R403.3.3. Prior to beginning sampling for testing, “Initial Testing” is required for each multifamily property. “Initial Testing” shall consist of the 3rd party testing contractor performing the required tests on at least three consecutive dwelling units. Test results from the “Initial Testing” must satisfy minimum code requirements before sampling is permitted. Dwelling units selected for the “Initial Testing” must be within the same building. Dwelling units selected for “Initial Testing” shall not be included in a “sample group” or counted toward the minimum 15% of dwelling units tested. The building official shall randomly select the three dwelling units for “Initial Testing.” The building official may delegate the random selection to the designated 3rd party testing contractor.

R403.3.4.1.1 (IRC N1103.3.4.1.1) Sample group Identification and Sampling. The builder shall identify a “sample group” which may be a building, floor, fire area or portion thereof. All of the dwelling units within the “sample group” must be at the same stage of construction and must be ready for testing. The building official shall randomly select at least 15% of dwelling units from each “sample group” for testing. The building official may delegate the random selection to the designated 3rd party testing contractor. If each tested dwelling unit within a “sample group” meets the minimum code requirements, then all dwelling units in the “sample group” are considered to meet the minimum code requirements.

Before a building may be deemed compliant with the testing as required, each “sample group” must be deemed compliant with the minimum code requirements. The sum total of all of the tested dwelling units across all “sample groups” shall not be less than a minimum of 15% of the dwelling units in a building.

R403.3.4.1.2 (IRC N1103.3.4.1.2) Failure to Meet Code Requirement(s). If any dwelling units within the identified “sample group” fail to meet a code requirement as determined by testing, the builder will be directed to correct the cause(s) of failure, and 30% of the remaining dwelling units in the “sample group” will be randomly selected for testing by the building official, or third-party testing contractor, regarding the specific cause(s) of failure. If any failures occur in the additional dwelling units, all remaining dwelling units in the sample group must be individually tested for code compliance.

A multifamily property with three failures within a 90-day period is no longer eligible to use the sampling protocol in that community or project until successfully repeating “Initial Testing.” Sampling may be reinstated after at least three consecutive dwelling units are individually verified to meet all code requirements.

A Certificate of Occupancy may not be issued for any building until testing has been performed and deemed to satisfy the minimum code requirements on the dwelling unit(s) identified for testing.

Reason: For many multifamily (R2 classifications) projects, it is very costly and time consuming to test each dwelling unit for projects where there may be dozens of dwelling units in each building. Considering that the same tradesman generally constructs a building, it is reasonable to deem that construction practices are consistent and that if a reasonable sampling of units tested pass then all units would pass. These amendments (originally drafted by the North Texas Council of Governments Energy and Green Advisory Board) or are very similar ordinances, have been accepted across Texas by the EHJs including the City of Dallas, the City of Austin, and the City of San Antonio.

Cost Impact: The code change proposal will decrease the cost of construction

This code change proposal will streamline the cost and time required to conduct on-site verification of Code which will result in lower testing costs and faster construction timelines

Proposal # 4589
IECC: R403.3.6.1 (IRC N1103.3.6.1)

**Proponent:** David Collins, SEHPCAC, representing SEHPCAC (SEHPCAC@iccsafe.org); David Collins, representing The American Institute of Architects (dcollins@preview-group.com)

**2018 International Energy Conservation Code**

**Revise as follows:**

R403.3.6.1 (IRC N1103.3.6.1) Effective R-value of deeply buried ducts (Mandatory). Where using a simulated energy performance analysis, sections of ducts that are: installed in accordance with Section R403.3.6; located directly on, or within 5.5 inches (140 mm) of the ceiling; surrounded with blown-in attic insulation having an R-value of R-30 or greater and located such that the top of the duct is not less than 3.5 inches (89 mm) below the top of the insulation, shall be considered as having an effective duct insulation R-value of R-25.

**Reason:** This section provides installation details related to a calculation methodology to be used in specific circumstances. There is no value or metric available for trade-offs in the performance path. As such, SEHPCAC believes this is a mandated, non-tradeable methodology for calculating R-value, and should be labeled mandatory.

Note that the SEHPCAC has a proposal to eliminate the use of the labels “prescriptive” and “mandatory” in favor of a tabular method of identifying non-tradeable requirements. If that proposal is successful ICC staff have stated that sections being individually approved to be labeled as ‘mandatory’ will instead have their respective section numbers added to the new C407.2 table of requirements that are non-tradeable in the performance path.

This proposal is submitted by the ICC Sustainable, Energy and High Performance Code Action Committee (SEHPCAC). The SEHPCAC was established by the ICC Board of Directors to pursue opportunities to improve and enhance International Codes with regard to sustainability, energy and high performance as it relates to the built environment included, but not limited to, how these criteria relate to the International Green Construction Code (IgCC) and the International Energy Conservation Code (IECC). In 2018-2019, the SEHPCAC has held five two- or three-day open meetings and numerous workgroup calls, to discuss and debate proposed changes and public comments. Attendees at the meetings and calls included members of the SEHPCAC as well as any interested parties. Related documentation and reports are posted on the SEHPCAC website at: http://www.iccsafe.org/cs/SEHPCAC/Pages/default.aspx

**Cost Impact:** The code change proposal will not increase or decrease the cost of construction. This does not change the design or construction requirements it makes mandatory the standard R-value calculation methodology.

Proposal # 4480

RE122-19
IECC: R403.4.1 (IRC N1103.4.1)

Proponent: Howard Ahern, representing self (howard.ahern@airexmfg.com)

2018 International Energy Conservation Code

Revise as follows:

R403.4.1 (IRC N1103.4.1) Protection of piping insulation (Mandatory). Piping insulation exposed to weather shall be protected from damage, including that caused by sunlight, moisture, equipment maintenance and wind. The protection shall provide shielding from solar radiation that can cause degradation of the material. Adhesive tape shall be prohibited.

Reason: The protection of pipe insulation should be a Mandatory requirement just as the requirement to insulate pipes of the heating or cooling system. As the commercial IECC requires protection as mandatory this residential, section needs to as well. Energy saving for insulating piping of heating and cooling systems is well researched and documented. Protecting this energy saving is crucial.

Example of saving from protecting the insulation can be measured in Dr Kourmohammadi PE, Ph.D. CPD, CIPE, CFPE LEED AP

“Insulation materials cannot endure physical impact or are fragile to many elements, i.e. weather. Weather impact on insulation is very high. The sun enhances the transforms the insulation from thermoplastic (soft) foam to thermoset (brittle) foam property. The property change also impacts the thermal conductivity of the material and consequently its performance. Protective covers become the sacrificial lamb and provide the stability in properties of the insulation.

Maintenance of pipes insulation is often non-existence. Aged insulation is generally brittle, poorly reinstalled, and subject to damage to the weather.”

Paper on Protective covers which calculated the BTU and Electrical energy saving of exposed Freon lines for residential and multifamily purposes . Freon lines exposed 3 ft to 5 ft

0.15/kwhr cost of electricity (peak demand cost can be at

0.25$/kwhr)

10 hours operation

365 days

¾” Freon line

½” insulation property 0.020227 Btu/(hr F ft)

For the California region it amounted to a $1.00 per foot annual savings

Example of cost saving average 5ft per unit in California with a population of 39 million and

If only half of the population for example had a heating and /cooling system with an average of 5ft exposed piping with degraded or no insulation , Protected pipe insulation would amount to an yearly electrical saving of $975,000,000

This is electrical saving and does not include the saving to home and building owners from not having a costly expenses of replacing insulation for maintenance
Bibliography: Impact and Advantages of Removable Insulation Protective Covers

Dr. “Saum” K. Nourmohammadi, PEx3, Ph.D. CPD, CIPE, CFPE, LEED AP

Cost Impact: The code change proposal will not increase or decrease the cost of construction
This change will not increase the cost of construction as protection is required by this section and by pipe insulation manufactures
IECC: R403.3.5 (IRC N1103.3.5)

Proponent: Ron Clements, Chesterfield County, representing Chesterfield County (clementsro@chesterfield.gov)

2018 International Energy Conservation Code
Delete without substitution:

R403.3.5 Building cavities (Mandatory). Building framing cavities shall not be used as ducts or plenums.

Reason: Duct system construction methods and materials is outside the scope of IRC chapter 11. Duct system construction is within the scope of IRC chapter 16. Section M1601.1.1 #7 allows the use of stud wall cavities for return air. This is a code correlation issue. If stud cavities should not be used under any circumstance then M1601.1.1 should be amended.

Cost Impact: The code change proposal will decrease the cost of construction
If approved this code change will allow use of wall cavity spaces as return duct plenums, which saves money that would need to be spent on return duct work.
IECC: R403.5.2 (IRC N1103.5.2)

Proponent: David Collins, SEHPCAC, representing SEHPCAC (SEHPCAC@iccsafe.org); David Collins, representing The American Institute of Architects (dcollins@preview-group.com)

2018 International Energy Conservation Code

Revise as follows:

R403.5.2 (IRC N1103.5.2) Demand recirculation water systems (Mandatory). Demand recirculation water systems shall have controls that comply with both of the following:

1. The controls shall start the pump upon receiving a signal from the action of a user of a fixture or appliance, sensing the presence of a user of a fixture or sensing the flow of hot or tempered water to a fixture fitting or appliance.
2. The controls shall limit the temperature of the water entering the cold water piping to not greater than 104°F (40°C).

Reason: There are no values or metrics for energy performance associated with Sec. R403.5.2. This means there is no value that can be used for trade-offs in the performance path. Because the provisions of R403.5.2 cannot be feasibly modeled or traded they should be labeled as mandatory.

The words "where installed" were added to make clear that Demand Recirculation Systems themselves are not required to be installed, but that where they are installed there is no value in trading the provisions in the performance path.

Note that the SEHPCAC has a proposal to eliminate the use of the labels "prescriptive" and "mandatory" in favor of a tabular method of identifying non-tradeable requirements. If that proposal is successful ICC staff have stated that sections being individually approved to be labeled as "mandatory" will instead have their respective section numbers added to the new C407.2 table of requirements that are non-tradeable in the performance path.

This proposal is submitted by the ICC Sustainable, Energy and High Performance Code Action Committee (SEHPCAC). The SEHPCAC was established by the ICC Board of Directors to pursue opportunities to improve and enhance International Codes with regard to sustainability, energy and high performance as it relates to the built environment included, but not limited to, how these criteria relate to the International Green Construction Code (IGCC) and the International Energy Conservation Code (IECC). In 2018-2019, the SEHPCAC has held five two- or three-day open meetings and numerous workgroup calls, to discuss and debate proposed changes and public comments. Attendees at the meetings and calls included members of the SEHPCAC as well as any interested parties. Related documentation and reports are posted on the SEHPCAC website at: http://www.iccsafe.org/cs/SEHPCAC/Pages/default.aspx

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

The code change may increase construction costs for a subset of buildings that may have been designed using the Total Building Performance or EIR compliance methods that included Demand recirculation water systems without the specified controls.
Add new text as follows:

R403.5.1 (IRC N1103.5.1) Water heating equipment. Service water heating equipment shall be one or more of the following types:

1. Storage gas water heater with a uniform energy factor (UEF) that meets the requirements of Table R403.5.1.
2. Storage electric water heater utilizing not less than 1.0 kW of on-site renewable energy.
3. Heat pump water heater with a UEF not less than 2.0.
4. Tankless water heater.
5. Grid-enabled water heater.
6. Solar water heating system having a solar fraction of not less than 0.5.

TABLE R403.5.1 (IRC N1103.5.1)

<table>
<thead>
<tr>
<th>FIRST HOUR RATING</th>
<th>MINIMUM UEF</th>
</tr>
</thead>
<tbody>
<tr>
<td>Very Small</td>
<td>0.24</td>
</tr>
<tr>
<td>Low</td>
<td>0.50</td>
</tr>
<tr>
<td>Medium</td>
<td>0.64</td>
</tr>
<tr>
<td>High</td>
<td>0.68</td>
</tr>
</tbody>
</table>

a. The first hour rating of a water heater is determined by the federal test procedure. It is listed on the Energy Guide label affixed to the water heater.

Add new definition as follows:

GRID-ENABLED WATER HEATER. An electric water heater that includes controls that enable activation for use as part of an electric thermal storage or demand response program.

SOLAR FRACTION. The fraction of total annual water heating energy met by a solar water heater.

Reason: This proposal improves the energy efficiency of the prescriptive path of the code while continuing to offer builders the same level of flexibility they already enjoy. Builders may still install any type of water heater that works for the home and location, including storage gas or electric water heaters. While it is true that not every home may be able to utilize every option listed, there is an option that is appropriate for any home. This proposal also modifies only the prescriptive path, which leaves builders the flexibility of the performance and ERI paths. This proposal is structured so that it does not trigger provisions of the National Appliance Energy Conservation Act (NAECA). See attached for a legal memorandum.

Residential envelopes have been getting tighter and better over the last few years. As a result, domestic water heating energy is emerging as a significant end-use from the efficiency standpoint. There are multiple ways of improving the efficiency of generating hot water in homes.

The US Department of Energy’s analysis for the standard that took effect in 2015 found that high-efficiency gas storage water heaters cost less upfront to install in new construction than standard efficiency models, due to lower venting costs of the high-efficiency equipment[1]. Furthermore, this efficiency level is cost-effective for customers compared to a standard model, saving more than $200 in energy costs. This means that customers will save money on their bills by installing a more efficient gas storage water heater and will pay less to purchase the efficient model than the less-efficient model. Gas furnaces that meet the Uniform Energy Factors specified in this proposal are widely available. Uniform Energy Factors are specified, per the DOE federal test procedure, based on the equipment’s First Hour Rating, which is clearly labeled on the yellow Energy Guide label affixed to each.

Storage electric water heaters may be installed, when coupled with solar energy. The purpose of this requirement is to offset the electricity used to heat the water, saving money for the consumer. In addition, solar energy is a strong selling point for a new home.

DOE analysis found that heat pump water heaters that replace electric storage water heaters are wildly cost-effective in all climate zones, in spite of their higher equipment costs. Homeowners will save more than $500 in energy costs compared to even an efficient electric storage water heater.
Tankless water heaters were cost-effective in the warmer climate zones, but were not as cost-effective in the colder climate zones.

As part of DOE’s appliance and equipment standards initiative, stakeholders expressed the importance of electric resistance water heaters to electric thermal storage (ETS) programs, so those grid-enabled water heaters are also incorporated into this proposal. Utilities use ETS programs, sometimes also known as load shifting or demand response programs, to manage peak demand load by limiting the times when certain appliances are operated. In certain water-heater based ETS programs, a utility typically controls a water heater remotely to allow operation only when electricity demand is during off-peak hours. During that off-peak operation, the electricity consumed is stored by the water heater as thermal energy for use during peak hours when the utility prevents the water heater from using electricity.

A solar water heating system can be designed in a variety of different ways. They can directly heat the water using the sun, can indirectly transfer heat from the sun to water in a storage tank, or can use pumps and valves to move water from collectors to a storage tank. They can have either gas or electric backup heating capabilities. This proposal requires at least half of the total energy delivered to the water heater to be generated through solar energy.

LEGAL MEMORANDUM CONCERNING NRDC’s PROPOSED R403.5.1 AND THE NATIONAL APPLIANCE ENERGY CONSERVATION ACT

Introduction

The Natural Resources Defense Council (NRDC) proposes the addition of R403.5.1 to Chapter 4 of the 2018 International Efficiency Conservation Code (IECC). The proposed addition prescribes six types of water heaters which may be installed by builders in order to comply with the prescriptive compliance pathway of IECC Chapter 4. Some commenters on similar past proposals expressed concern that such a provision would be preempted by the National Appliance Energy Conservation Act, which amended the Energy Policy Conservation Act and set up the energy efficiency standards program for appliances, including water heaters. This is not the case. The proposed code addition comports with the federal statutory provision for building codes because it does not require installation of water heaters that exceed the current federal minimum level.

Legal Analysis

As explained in greater detail below, the issue is whether these proposed additions would effectively require builders to use products that are more efficient than required by federal efficiency standards and thus would trigger preemption. Because they do not there is no preemption concern here.

The National Appliance Energy Conservation Act provides that state building codes may include provisions concerning the efficiency of appliances covered by federal efficiency standards if they meet seven specified requirements. Commenters in the past expressed concern that the provision would not meet two of these requirements: Sections 6297(f)(3)(B) and 6297(f)(3)(E). The basic requirement of these two provisions is that the building code not require use of an appliance more efficient than the level set by the Department of Energy under the Act.

The first of these focuses on the code as a whole. It states, in relevant part, that the code may not "require that the covered product have an energy efficiency exceeding the applicable energy conservation standard . . . ." The second provision concerns building codes that offer optional combinations of items. Our proposed changes easily satisfy this provision because, as discussed below,

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1 This memorandum is submitted as an attachment to NRDC’s July 21, 2016 proposed amendment.
3 It is not clear whether the optional “combinations of items” applies to the prescriptive pathway at all. 42 U.S.C. § 6297(f)(3)(C). Assuming that it does, we believe the relevant “combination” would be the combination of each of the different water heater options and the rest of the prescriptive options. The proposed standard avoids preemption because it includes multiple optional combinations that include minimum efficiency water heaters and only two that require higher efficiency appliances.
four of the six options do not involve products that exceed existing federal standards. (A fifth option may not require a standard-exceeding product depending on the first hour rating of the water heater.)

The presence of some more efficient options does not trigger preemption. In interpreting these provisions, the Ninth Circuit Court of Appeals has recognized that "a builder is not ‘required’ to select a [more efficient] option . . . simply because there is an economic incentive to do so."4

The proposed amendment would not be preempted because it allows installation in new residential buildings of minimum-efficiency water heaters. The statutory preemption test focuses on the "covered product," which is defined in this case as water heaters.5 Thus, a building code is not preempted so long as it does not require installation of a covered product—in this case a water heater—that is above the minimum efficiency level. The proposed amendment plainly does not do so for several reasons. First, the performance path (Section 405) and the Energy Rating Index path (Section 406) focus on overall energy use and include no water heater requirements at all.

Second, even just considering the prescriptive pathway, the proposed amendment still does not require use of a water heater that exceeds minimum federal standards. The proposed amendment allows builders to select any of the six prescribed types of water heaters, at least two of which clearly do not exceed the federal requirements: tankless water heaters (R403.5.1.4) and grid-enabled water heaters (R403.5.1.5). For tankless water heaters, the proposed code amendment contains no minimum efficiency standard and thus the federal standards would apply.6 For grid-enabled water heaters, the proposed code complies with the federal provision.7 As such, builders can comply with the standard by using water heaters that meet, but do not exceed, federal efficiency standards. Indeed, even if these minimum efficiency options were not available, the prescriptive path would still not "require" use of higher efficiency water heaters since any type of water heater can be used under the prescriptive approach if combined with other options such as a solar water heater.8

The proposed amendment is also similar to existing building code provisions. The prescriptive compliance path in California’s 2016 building code, for instance, requires installation of either gas/propane instantaneous water heaters or gas/propane storage type water heaters in new residential dwellings.9 California’s prescriptive compliance path allows use of certain minimum efficiency water heaters but does not allow use of every type of minimum efficiency water heater. Like the proposed

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7 Id.
8 See Building Industry Ass’n of Wash., 683 F.3d at 1151.
code, the California code allows builders to choose an alternate compliance path, which allows use of any water heater.\textsuperscript{19}

Conclusion

The core requirement for a building code to avoid preemption is that it not require above-minimum efficiency appliances. This requirement is met by the NRDC proposal because the proposal offers multiple ways that minimum efficiency water heaters can be used under both the prescriptive and performance pathways.


Cost Impact: The code change proposal will not increase or decrease the cost of construction
This proposal provides a list of options for a builder to choose from. In some instances the builder may choose an option which increases construction costs, but there are many options that will not increase costs. For instance, the US Department of Energy's analysis for the water
heater standard that took effect in 2015 found that high-efficiency gas storage water heaters cost less upfront to install in new construction than standard efficiency models, due to lower venting costs of the high-efficiency equipment.
2018 International Energy Conservation Code

Revise as follows:

R403.5.3 (IRC N1103.5.3) Hot water pipe insulation (Prescriptive). Insulation for service hot water piping with a thermal resistance, R-value, of not less than R-3 shall be applied to the following:

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

Reason: The change clarifies the intent of the requirements which require all piping in items 2 through 7 to be insulated regardless of pipe diameter. The exemption in item 7 is further clarified by not requiring insulation on the "cold water pipe return" in a demand recirculation system.

This proposal is submitted by the ICC Sustainable, Energy and High Performance Code Action Committee (SEHPCAC). The SEHPCAC was established by the ICC Board of Directors to pursue opportunities to improve and enhance International Codes with regard to sustainability, energy and high performance as it relates to the built environment included, but not limited to, how these criteria relate to the International Green Construction Code (IgCC) and the International Energy Conservation Code (IECC). In 2018-2019, the SEHPCAC has held five two- or three-day open meetings and numerous workgroup calls, to discuss and debate proposed changes and public comments. Attendees at the meetings and calls included members of the SEHPCAC as well as any interested parties. Related documentation and reports are posted on the SEHPCAC website at: http://www.iccsafe.org/cs/SEHPCAC/Pages/default.aspx

Cost Impact: The code change proposal will not increase or decrease the cost of construction. This is a clarification only, not an additional design or construction requirement.
RE128-19
IEEC: R403.5.3 (IRC N1103.5.3)

Proponent: David Collins, SEHPCAC, representing SEHPCAC (SEHPCAC@iccsafe.org); David Collins, representing The American Institute of Architects (dcollins@preview-group.com)

2018 International Energy Conservation Code

Revise as follows:

R403.5.3 (IRC N1103.5.3) Hot water pipe insulation (Prescriptive Mandatory). Insulation for hot water piping with a thermal resistance, \( R \)-value, of not less than \( R-3 \) shall be applied to the following:

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

Reason: Because the provisions of R403.5.3 cannot be feasibly modeled or traded; and because of there is no design reason to attempt to model it, R403.5.3 should be labeled as mandatory.

Note that the SEHPCAC has a proposal to eliminate the use of the labels “prescriptive” and “mandatory” in favor of a tabular method of identifying non-tradeable requirements. If that proposal is successful ICC staff have stated that sections being individually approved to be labeled as ‘mandatory’ will instead have their respective section numbers added to the new C407.2 table of requirements that are non-tradeable in the performance path.

This proposal is submitted by the ICC Sustainable, Energy and High Performance Code Action Committee (SEHPCAC). The SEHPCAC was established by the ICC Board of Directors to pursue opportunities to improve and enhance International Codes with regard to sustainability, energy and high performance as it relates to the built environment included, but not limited to, how these criteria relate to the International Green Construction Code (IgCC) and the International Energy Conservation Code (IECC). In 2018-2019, the SEHPCAC has held five two- or three-day open meetings and numerous workgroup calls, to discuss and debate proposed changes and public comments. Attendees at the meetings and calls included members of the SEHPCAC as well as any interested parties. Related documentation and reports are posted on the SEHPCAC website at: http://www.iccsafe.org/cs/SEHPCAC/Pages/default.aspx

Cost Impact: The code change proposal will increase the cost of construction. Although SEHPCAC has been assured pipe insulation is industry practice, this code change may increase construction costs for a subset of buildings that were not insulating pipes.

Proposal # 4485
Proponent: David Collins, SEHPCAC, representing SEHPCAC (SEHPCAC@iccsafe.org); David Collins, representing The American Institute of Architects (dcollins@preview-group.com)

2018 International Energy Conservation Code

Revise as follows:

R403.5.4 (IRC N1103.5.4) Drain water heat recovery units (Mandatory). Drain water heat recovery units shall comply with CSA B55.2. Drain water heat recovery units shall be tested in accordance with CSA B55.1. Potable water-side pressure loss of drain water heat recovery units shall be less than 3 psi (20.7 kPa) for individual units connected to one or two showers. Potable water-side pressure loss of drain water heat recovery units shall be less than 2 psi (13.8 kPa) for individual units connected to three or more showers.

Reason: Because the provisions of R403.5.4 cannot be feasibly modeled or traded; and because of there is no design reason to attempt to model it, R403.5.4 should be labeled as mandatory (non-tradeable).

Note that the SEHPCAC has a proposal to eliminate the use of the labels "prescriptive" and "mandatory" in favor of a tabular method of identifying non-tradeable requirements. If that proposal is successful ICC staff have stated that sections being individually approved to be labeled as 'mandatory' will instead have their respective section numbers added to the new C407.2 table of requirements that are non-tradeable in the performance path.

This proposal is submitted by the ICC Sustainable, Energy and High Performance Code Action Committee (SEHPCAC). The SEHPCAC was established by the ICC Board of Directors to pursue opportunities to improve and enhance International Codes with regard to sustainability, energy and high performance as it relates to the built environment included, but not limited to, how these criteria relate to the International Green Construction Code (IgCC) and the International Energy Conservation Code (IECC). In 2018-2019, the SEHPCAC has held five two- or three-day open meetings and numerous workgroup calls, to discuss and debate proposed changes and public comments. Attendees at the meetings and calls included members of the SEHPCAC as well as any interested parties. Related documentation and reports are posted on the SEHPCAC website at:

http://www.iccsafe.org/cs/SEHPCAC/Pages/default.aspx

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

Although SEHPCAC has been assured this is standard industry practice, the code change may increase construction costs for a subset of buildings that may have been designed to include drain water heat recovery but not in accordance with the specified standard.

Proposal # 4487

RE129-19
RE130-19
IECC: R403.6.2 (IRC N1103.6.2) (New)

Proponent: Robby Schwarz, EnergyLogic, representing EnergyLogic (robby@nrglogic.com)

2018 International Energy Conservation Code
Add new text as follows:

R403.6.2 (IRC N1103.6.2) Testing. Mechanical ventilation systems shall be tested and verified to provide the minimum ventilation flow rates required by Section R403.6. Testing shall be performed according to the ventilation equipment manufacturer’s instructions, or by using a flow hood or box, flow grid, or other airflow measuring device at the mechanical ventilation fan’s inlet terminals or grilles, outlet terminals or grilles, or in the connected ventilation ducts. Where required by the code official, testing shall be conducted by an approved third party. A written report of the results of the test shall be signed by the party conducting the test and provided to the code official.

Exception: Kitchen range hoods that are ducted to the outside with 6” or larger duct and one or less 90° elbow or equivalent in the duct run are exempt from this requirement to test air flow.

Reason: As we continue to be guided by sound building science to build tight homes as required by the IECC to achieve better predictability and control of air flow, thermal flow, and moisture flow spot/local and whole house ventilation becomes an even more crucial aspect of ensuring that the full intent of the IECC is met. This includes durability, safety, healthy, flexibility in how we build, as well as, efficiency of the structure. If we do not more actively ensure that the systems in our homes are not only there, but are also performing as intended we have missed the mark with regards to the intent of the code and creating dwellings that are durable, safe, healthy, and efficient. The testing experience gained through the verification of the EnergyStar program has clearly demonstrated that ventilation fans are installed but are not performing as required by the code. Fan rated flow does not equate to the flow that is actually produced once a fan has been installed. The quality of the installation of the duct from the fan to the termination of the duct to the outside, as well as, the quality of the termination device ultimately governs the amount of air that any fan can push. Simple cost-effective testing is available to ensure that the systems in our homes are not only there but have been installed in such a way that they work as intended by the code.

Allison Bailes Energy Vanguard blog post titled, “The 2 Main Problems With Kitchen Ventilation” which can be found here https://www.energyvanguard.com/blog/2-main-problems-kitchen-ventilation Offers additional rational regarding the consequences of poor ventilation from research conducted by Brett Singer and others at Lawrence Berkeley Laboratory. If you are interested there are additional links at the end of his post to related articles that further discuss this issue. I offer this background information to demonstrate that beyond the physical failure of measured fan flow to meet the requirements of code, that there is an extensive study being produced on the effects of improper ventilation. Requiring testing of spot/local and whole house ventilation system will move the building industry into compliance with the code by offering direct feedback on the fan choice and the installation. In the most flexible way possible this feedback will guide fan choice and installation techniques that will become compliant with the code.

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

The cost implications of this code change are small. Qualified testing personnel are already available and at the building performing blower door and duct leakage tests. Adding simple flow measurements of ventilation systems at the same time a blower door test occurs, for example, is not only practical but cost-effective. An increase is cost of $25-$50 is well worth the reduction in builder risk, occupant health, and efficiency issues that are associated with poor implementation of code required moisture and pollutant management.

Proposal # 5249
RE131-19

Proponent: Robby Schwarz, EnergyLogic, representing EnergyLogic (robbyschwarz@energylogic.com); Shaunna Mozingo (smdozingo@shaunnamozingo.com)

2018 International Energy Conservation Code

Add new text as follows:

R403.6 (IRC N1103.6) Mechanical Ventilation (Mandatory). The building shall be provided with ventilation that meets the requirements of the International Residential Code or International Mechanical Code, as applicable, or with other approved means of ventilation. Outdoor air intakes and exhausts shall have automatic or gravity dampers that close when the ventilation system is not operating.

R403.6.1 (IRC N1103.6.1) Heat recovery ventilation (Prescriptive). The building shall be provided with a heat recovery or energy recovery ventilation system in climate zones 7 and 8. The system shall be balanced with a minimum sensible heat recovery efficiency of 65% at 32°F (0°C) and at rated airflow.

Revise as follows:

R403.6.1.2 (IRC N1103.6.1.2) Whole-house mechanical ventilation system fan efficacy. Fans used to provide whole-house mechanical ventilation shall meet the efficacy requirements of Table R403.6.1.

Exception: Where an air handler that is integral to tested and listed HVAC equipment is used to provide whole-house mechanical ventilation, the air handler shall be powered by an electronically commutated motor.

Reason: How does the proposed measure compare to what's required in current codes? The national model energy code for residential buildings, the International Energy Conservation Code (IECC), does not require heat recovery ventilation, though it does establish minimum efficacy ratings for HRV fans if a home has one. All new homes are currently required to have mechanical ventilation based on the International Residential Code (IRC), with continuous fresh air requirements ranging from 30 to 165 CFM depending on the home's conditioned floor area and number of bedrooms. For dwelling units between 1200 ft² and 4500 ft², with two to four bedrooms, the range is 45 to 90 CFM.

Why is heat recovery a better approach to ventilation than alternatives? In years past, the overall leakiness of building envelopes provided sufficient fresh air for occupants, but brought with it substantial energy penalties and comfort issues from widely varying ventilation rates depending on outdoor temperature and wind speed. As construction practices have gained better control of envelope leakage, mechanical ventilation systems have become a necessity and are required by modern building codes. In sufficiently cold climates, heat recovery can enhance comfort—as occupants are not subjected to uncomfortably cold supply air—and may be cost effective in their recovery of heat that would otherwise be exhausted.

HRVs have experienced significant growth in the residential market in recent years. This market is projected to continue growing at 11% per year per MarketsandMarkets (2018). North America is the largest market in the world for HRVs.

ERVs are not considered in this paper because their performance and cost effectiveness is more dependent on local humidity and on the interplay of heating and cooling performance. These factors do not map as cleanly to the high-level climate zones typically used in state and local building energy codes.

How is system performance demonstrated in the field? HRVs come in several forms, ranging from systems integrated into the HVAC distribution system, to separate systems with their own ductwork, to simple unducted heat exchangers. System performance is easy to verify based on the unit's nameplate performance ratings and straightforward inspection of the installation.

Cost Impact: The code change proposal will not increase or decrease the cost of construction. The cost of HRV equipment ranges from about $500 to a few thousand dollars, depending on the manufacturer, capacity, configuration, and the base design of the home. The present analysis assumes a total measure cost of $1,500 for a single-point HRV system. NREL (2018) gives a cost of $1,300, inclusive of equipment and installation. Russell, Sherman and Rudd (2007) found a similar cost of $1,350 including installation. Fixr.com (2018), a home remodeling website, gives a range of $1,200 to $1,550, inclusive of materials and installation. Moore (2018) suggests a typical cost of $1,500. This analysis uses a primary first cost of $1,500 for an HRV in a typical dwelling unit as a best estimate that includes installation. It is acknowledged that real costs can vary greatly, especially if the cost of installation is minimized, as when the home was already designed to integrate ventilation into the distribution system. In that case, the HRV cost can be quite low. To show the sensitivity of HRV cost effectiveness to first cost, a secondary cost of $500 was evaluated in addition to the primary cost of $1,500.

Cost-effectiveness: At a first cost of $1,500, the life-cycle cost of an HRV is negative (i.e., life-cycle savings is positive) in climate zones 7 and 8, as shown in Table 2 of the attached PNL Residential Heat Recovery Ventilation Technical Brief.
RE132-19 Part I

PART I — IECC: R403.6 (IRC N1103.6)
PART II — IRC®: R303.4

Proponent: Mike Moore, representing Broan-NuTone (mmoore@newportventures.net)

2018 International Energy Conservation Code

Revise as follows:

R403.6 (IRC N1103.6) Mechanical ventilation (Mandatory). The building Buildings and dwelling units shall be provided with mechanical ventilation that complies with the requirements of the International Residential Code or International Mechanical Code, as applicable, or with other approved means of ventilation. Outdoor air intakes and exhausts shall have automatic or gravity dampers that close when the ventilation system is not operating.
2018 International Residential Code

Revise as follows:

R303.4 Mechanical ventilation. Where the air infiltration rate of a dwelling unit is 5 air changes per hour or less when tested with a blower door at a pressure of 0.2 inch w.c. (50 Pa) in accordance with Section N1102.4.1.2, the dwelling unit Dwelling units complying with Section N1102.4.1 shall be provided with whole-house mechanical ventilation in accordance with Section M1505.4.

Reason: Changes to R303.4
Section N1102.4 establishes MANDATORY requirements for air sealing of the building envelope, including mandatory requirements to follow the air barrier and insulation installation criteria in Table N1102.4.1.1 and the mandatory blower door testing and verification requirements in Section N1102.4.1.2. Further, all dwelling units complying with Section N1102.4 require a blower door test with results that achieve 5 ACH50 or less. Thus, all dwelling units complying with Section N1102.4 already require whole-house mechanical ventilation. This change simplifies Section R303.4 and future-proofs the intent of the section by ensuring that tight dwelling units will continue to be provided with whole-house mechanical ventilation, regardless of the metric used to verify that the dwelling units are tight (e.g. there are several proposals being heard in Group B that would move from the metric of ACH50 to a metric of cfm50/ft2).

These changes are aligned with Group A action on proposal M20. M20 was approved and removed the specific reference to 5 ACH50 as the air leakage metric that triggers a mechanical ventilation requirement in Section 401.2 of the IMC as follows:

401.2 Ventilation required. Every occupied space shall be ventilated by natural means in accordance with Section 402 or by mechanical means in accordance with Section 403. <Strikeout the following text: Where the air infiltration rate in a dwelling unit is less than 5 air changes per hour when tested with a blower door at a pressure of 0.2-inch water column (50 Pa) in accordance with Section R402.4.1.2 of the International Energy Conservation Code, the dwelling unit shall be ventilated by ... End strikeout section > Dwelling units complying with the air leakage requirements of the International Energy Conservation Code or ASHRAE 90.1 shall be ventilated by mechanical means in accordance with Section 403.

Changes to Section 403.6

In keeping with IRC Section R303.4 and IMC Section 401.2, the heading of section 403.6 requires “mechanical” ventilation for buildings complying with the IECC-Residential. To clarify that this is the intent of this section and is coordinated with the IRC and IMC (which contain mechanical ventilation requirements for buildings and dwelling units), the words “mechanical” and “dwelling units” are proposed for inclusion within the text of R403.6.

These changes are aligned with Group A action on proposal M20. M20 was approved and removed the specific reference to 5 ACH50 as the air leakage metric that triggers a mechanical ventilation requirement in Section 401.2 of the IMC as follows:

401.2 Ventilation required. Every occupied space shall be ventilated by natural means in accordance with Section 402 or by mechanical means in accordance with Section 403. <Strikeout the following text: Where the air infiltration rate in a dwelling unit is less than 5 air changes per hour when tested with a blower door at a pressure of 0.2-inch water column (50 Pa) in accordance with Section R402.4.1.2 of the International Energy Conservation Code, the dwelling unit shall be ventilated by ... End strikeout section > Dwelling units complying with the air leakage requirements of the International Energy Conservation Code or ASHRAE 90.1 shall be ventilated by mechanical means in accordance with Section 403.

Cost Impact: The code change proposal will not increase or decrease the cost of construction
This proposal is a clarification of current requirements of the IRC, IMC, and IECC and does not increase or decrease the cost of construction.

Proposal # 5696

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ICC COMMITTEE ACTION HEARINGS :::: April, 2019
RE133-19

IECC: TABLE R403.6.1 (IRC N1103.6.1)

**Proponent:** Eric Makela, representing New Buildings Institute (ericm@newbuildings.org); Mike Moore, Newport Ventures, representing Broan-NuTone (mmoore@newportventures.net)

**2018 International Energy Conservation Code**

**Revise as follows:**

### TABLE R403.6.1 (IRC N1103.6.1)

**WHOLE-HOUSE MECHANICAL VENTILATION SYSTEM FAN EFFICACY**

<table>
<thead>
<tr>
<th>FAN LOCATION</th>
<th>AIR FLOW RATE 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 cfm/watt</td>
<td>Any</td>
</tr>
<tr>
<td>Range hoods</td>
<td>Any</td>
<td>2.8 cfm/watt</td>
<td>Any</td>
</tr>
<tr>
<td>In-line fan</td>
<td>Any</td>
<td>≥ 3.8 cfm/watt</td>
<td>Any</td>
</tr>
<tr>
<td>Bathroom, utility room</td>
<td>10</td>
<td>≥ 4.4 cfm/watt, &lt; 90</td>
<td></td>
</tr>
<tr>
<td>Bathroom, utility room</td>
<td>90</td>
<td>≥ 3.5 cfm/watt</td>
<td>Any</td>
</tr>
</tbody>
</table>

For SI: 1 cfm = 28.3 L/min.

a. When tested in accordance with HVI Standard 916.

**Reason:** Whole-house ventilation fan efficacies were introduced in the code in 2012 for low-rise residential buildings and have not been updated since. The current residential fan efficacies are from an older version of Energy Star. This proposal will update the requirements to the latest Energy Star requirement Version 4.0. The fan efficacy values are very conservative based on what is currently on the market. Although they are substantially better than current requirements, they are still lower than the average efficiency of fans in the Home Ventilating Institute's fan database. These requirements are below the average efficiency for each fan type on the market and reflect hundreds of available options, but higher than the standard set in the residential code. For example, according to the HVI database of fans, the average efficiency of bath fans is around 8 CFM/W.

A proposal has also been submitted to add similar requirements for similar low-capacity fans in the commercial section of the code.

**Cost Impact:**

The code change proposal will not increase or decrease the cost of construction. The proposal is not expected to increase the cost of construction. The cost for the kinds of fans covered by this requirement are driven primarily by flow rate, finishes, design and noise and whether they include other features like lights or heaters and not efficiency. Fans that meet this requirement can be obtained for less than other fans that do not. A survey of pricing from a major retailer revealed that the lowest cost bathroom fans from major manufacturers that currently comply with Table R403.6.1 would also comply with the proposed increase in efficacy, resulting in no cost increase.

Lowest cost exhaust fans for major manufacturers meeting current IECC fan efficacy requirement at 0.1” w.c. and IRC flow rate requirement at 0.25” w.c, flow < 90 cfm:

<table>
<thead>
<tr>
<th>Fan</th>
<th>Efficacy at 0.1” w.c.</th>
<th>Flow at 0.25” w.c.</th>
</tr>
</thead>
<tbody>
<tr>
<td>AirKing BFQ75</td>
<td>3.0</td>
<td>70</td>
</tr>
<tr>
<td>DeltaBreeze SLM70</td>
<td>4.7</td>
<td>54</td>
</tr>
<tr>
<td>Broan AE80B</td>
<td>3.0</td>
<td>60</td>
</tr>
</tbody>
</table>

Pricing for these fans ranged between $35-$53 retail. Note that the fan efficacy for each of these lowest-cost fans that are currently complaint with the IECC and IRC would also comply with the proposed revision in fan efficacy to 2.8 cfm/W, so there is no additional cost.

Lowest cost exhaust fans for major manufacturers meeting current IECC fan efficacy requirement at 0.1” w.c. and IRC flow rate requirement at 0.25” w.c, flow ≥ 90 cfm:

<table>
<thead>
<tr>
<th>Fan</th>
<th>Efficacy at 0.1” w.c.</th>
<th>Flow at 0.25” w.c.</th>
</tr>
</thead>
<tbody>
<tr>
<td>AirKing AK110LS</td>
<td>3.9</td>
<td>90</td>
</tr>
<tr>
<td>DeltaBreeze VFB25AEH</td>
<td>5.9</td>
<td>105</td>
</tr>
</tbody>
</table>
Pricing for these fans ranged between $89-$105 retail. Note that the fan efficacy for each of these lowest-cost fans that are currently complaint with the IECC and IRC would also comply with the proposed revision in fan efficacy to 3.5 cfm/W, so there is no additional cost.

RE134-19
IECC: R403.6.1 (IRC N1103.6.1), TABLE R403.6.1 (IRC N1103.6.1)

Proponent: Aaron Gary, representing Self (aaron.gary@texenergy.org)

2018 International Energy Conservation Code
Revise as follows:

R403.6.1 (IRC N1103.6.1) Whole-house Whole-dwelling mechanical ventilation system fan efficacy. Fans used to provide whole-house mechanical ventilation shall meet the efficacy requirements of Table R403.6.1.

Exception: Where an air handler that is integral to tested and listed HVAC equipment is used to provide whole house mechanical ventilation, the air handler shall be powered by an electronically commutated motor.

TABLE R403.6.1 (IRC N1103.6.1)
WHOLE-HOUSE WHOLE-DWELLING MECHANICAL VENTILATION SYSTEM FAN EFFICACY

<table>
<thead>
<tr>
<th>FAN LOCATION</th>
<th>AIR FLOW RATE 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 cfm/watt</td>
<td>Any</td>
</tr>
<tr>
<td>Range hoods</td>
<td>Any</td>
<td>2.8 cfm/watt</td>
<td>Any</td>
</tr>
<tr>
<td>In-line fan</td>
<td>Any</td>
<td>2.8 cfm/watt</td>
<td>Any</td>
</tr>
<tr>
<td>Bathroom, utility room</td>
<td>10</td>
<td>1.4 cfm/watt</td>
<td>&lt; 90</td>
</tr>
<tr>
<td>Bathroom, utility room</td>
<td>90</td>
<td>2.8 cfm/watt</td>
<td>Any</td>
</tr>
<tr>
<td>Air-handler that is integrated to tested and listed HVAC equipment</td>
<td>Any</td>
<td>1.2 cfm/watt</td>
<td>Any</td>
</tr>
</tbody>
</table>

For SI: 1 cfm = 28.3 L/min.

a. When tested in accordance with HVI Standard 916.
b. Design outdoor airflow rate / watts of fan used

Reason: Typical Integrated whole-dwelling mechanical ventilation systems, even those that are using ECM motors, use significantly more energy than the other fan locations allowed under R403.6.1. Analyses using ERI approved software calculate the increase in annual energy usage for an integrated while-dwelling mechanical ventilation system to be up to 10x when compared to an independent in-line fan. As such requiring integrated mechanical ventilation system to perform equally to at least the most energy inefficient of the other styles of systems in this table could result in significant energy savings.

Footnote b. clarifies how the CFM/watt should be calculated by specifying that the CFM of Outdoor mechanical ventilation air should be used for this calculation and not the total airflow of the system delivering the air. Some ventilation systems use a single fan to deliver mixed outdoor and with indoor "return" air. For this calculation only the outdoor airflow should be used in lieu of the total airflow of the fan. This is a common misunderstanding we encounter associated C403.7.4 as well.

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

For buildings that are already using an independent fan strategy (exhaust, supply, or balanced) or an integrated fan strategy that utilizes a small enough horsepower motor, this proposal will not increase or decrease the cost of construction. For buildings that are currently using standard AHU/Furnace fan motors as their mechanical ventilation fan, the cost of construction may increase as they will need to adjust their mechanical ventilation design strategy in order to comply.

Proposal # 4556
RE135-19

IECC: R403.6.1 (IRC N1103.6.1), TABLE R403.6.1 (IRC N1103.6.1)

Proponent: Aaron Gary, representing Self (aaron.gary@texenergy.org)

2018 International Energy Conservation Code

Revise as follows:

R403.6.1 (IRC N1103.6.1) Whole-house whole-dwelling mechanical ventilation system fan efficacy. Fans used to provide whole-house whole-dwelling mechanical ventilation shall meet the efficacy requirements of Table R403.6.1.

Exception: Where an air handler that is integral to tested and listed HVAC equipment is used to provide whole-house mechanical ventilation, the air handler shall be powered by an electronically commutated motor.

<table>
<thead>
<tr>
<th>FAN LOCATION</th>
<th>AIR FLOW RATE 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 cfm/watt</td>
<td>Any</td>
</tr>
<tr>
<td>Range hoods</td>
<td>Any</td>
<td>2.8 cfm/watt</td>
<td>Any</td>
</tr>
<tr>
<td>In-line fan</td>
<td>Any</td>
<td>2.8 cfm/watt</td>
<td>Any</td>
</tr>
<tr>
<td>Bathroom, utility room</td>
<td>10</td>
<td>1.4 cfm/watt</td>
<td>&lt; 90</td>
</tr>
<tr>
<td>Bathroom, utility room</td>
<td>90</td>
<td>2.8 cfm/watt</td>
<td>Any</td>
</tr>
</tbody>
</table>

For SI: 1 cfm = 28.3 L/min.

a. When tested in accordance with HVI Standard 916.

Reason: “Whole-house” is too limiting a phrase as this Code governs, and these systems are installed, in dwellings other than houses with apartments that are 3-stories and lower being the most common. Further the term dwelling is used in the IMC in relation to ventilation systems in lieu of house.

Cost Impact: The code change proposal will not increase or decrease the cost of construction. Revision is clarifying in nature and does not change the requirements of the Code.

Proposal # 4621
2018 International Energy Conservation Code

Revise as follows:

<table>
<thead>
<tr>
<th>TABLE R403.6.1 (IRC N1103.6.1)</th>
</tr>
</thead>
<tbody>
<tr>
<td>WHOLE-HOUSE MECHANICAL VENTILATION SYSTEM FAN EFFICACY*</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>FAN LOCATION</th>
<th>AIR FLOW RATE 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 cfm/watt</td>
<td>Any</td>
</tr>
<tr>
<td>Range hoods</td>
<td>Any</td>
<td>2.8 cfm/watt</td>
<td>Any</td>
</tr>
<tr>
<td>In-line fan</td>
<td>Any</td>
<td>2.8 cfm/watt</td>
<td>Any</td>
</tr>
<tr>
<td>Bathroom, utility room</td>
<td>10</td>
<td>1.4 cfm/watt</td>
<td>&lt; 90</td>
</tr>
<tr>
<td>Bathroom, utility room</td>
<td>90</td>
<td>2.8 cfm/watt</td>
<td>Any</td>
</tr>
</tbody>
</table>

For SI: 1 cfm = 28.3 L/min.

a. When tested in accordance with HVI Standard 916. Fan efficacy for HRV, ERV, balanced, and in-line fans shall be taken at a static pressure >= 0.2 in. w.c. Fan efficacy for range hoods, bathroom, and utility room fans shall be taken at a static pressure >= 0.1 in. w.c.

Reason: Fan efficacy varies as a function of static pressure, so it is necessary to identify the minimum static pressure required for determining the rating. These pressures are aligned with industry practice and ENERGY STAR’s requirements for reporting fan efficacy.

Cost Impact: The code change proposal will not increase or decrease the cost of construction. This proposal clarifies a current requirement of the code. There is no expected change in construction costs.
2018 International Energy Conservation Code

Revise as follows:

TABLE R403.6.1 (IRC N1103.6.1)
WHOLE-HOUSE MECHANICAL VENTILATION SYSTEM FAN EFFICACY*

<table>
<thead>
<tr>
<th>SYSTEM TYPE-FAN LOCATION</th>
<th>AIR FLOW RATE MINIMUM (CFM)</th>
<th>MINIMUM EFFICACY (CFM/WATT)</th>
<th>AIR FLOW RATE MAXIMUM (CFM)</th>
</tr>
</thead>
<tbody>
<tr>
<td>HRV, or ERV, or balanced</td>
<td>Any</td>
<td>1.2 cfm/watt</td>
<td>Any</td>
</tr>
<tr>
<td>Range hoods</td>
<td>Any</td>
<td>2.8 cfm/watt</td>
<td>Any</td>
</tr>
<tr>
<td>In-line supply or exhaust fan</td>
<td>Any</td>
<td>2.8 cfm/watt</td>
<td>Any</td>
</tr>
<tr>
<td>Other exhaust fan</td>
<td>Bathroom, utility room</td>
<td>1.4 cfm/watt</td>
<td>&lt; 90</td>
</tr>
<tr>
<td></td>
<td>Bathroom, utility room</td>
<td>2.8 cfm/watt</td>
<td>&gt;= 90</td>
</tr>
</tbody>
</table>

For SI: 1 cfm = 28.3 L/min.

Reason: Changes proposed to this table are for clarification and simplification. First, the table should not be based on the location of the fan but on the type of fan being installed. For example, an HRV or ERV is not a location, but a system type. Balanced fans without heat recovery are currently omitted from the table, and should be listed along side HRVs and ERVs, which are also balanced systems. Because balanced fans are grouped with HRVs and ERVs, the use of the term "in-line fan" should be clarified to include supply and exhaust in-line systems (also not a location, but a system type). Finally, if a "bathroom" fan is installed in a hallway to provide ventilation (a typical installation location for whole-house mechanical ventilation systems), the current table is silent on the minimum efficacy required, because it does not address "hallway" fans. So, this proposal combines typical bathroom, utility room, range hood, and hallway exhaust fans into the category of "other exhaust fans"; no changes are made to the fan efficacies for these products (note that the minimum flow rate for intermittent range hoods permitted by the IRC is 100 cfm, corresponding to a minimum efficacy of 2.8 cfm/W under the original and proposed versions of the table). The last column can be deleted by changing the "Air Flow Rate Minimum" column heading to "Air Flow Rate".

Cost Impact: The code change proposal will not increase or decrease the cost of construction.

These changes are for clarification and simplification purposes and do not increase or decrease the cost of construction.

Proposal # 5413
IECC: R403.6.1 (IRC N1103.6.1)

Proponent: Mike Moore, Newport Ventures, representing Broan-NuTone (mmoore@newportventures.net)

2018 International Energy Conservation Code

Revise as follows:

R403.6.1 (IRC N1103.6.1) Whole-house mechanical ventilation system fan efficacy. Fans used to provide whole-house mechanical ventilation shall meet the efficacy requirements of Table R403.6.1.

Exception: Where an air handler that is integral to tested and listed HVAC equipment is used to provide whole-house mechanical ventilation, the air handler shall be Space heating or cooling air handlers shall not supply whole-house ventilation except when operating to provide heating or cooling, unless the air handler fan is powered by an electronically commutated motor and the project complies with R401.2.2 or R401.2.3.

Reason: The prescriptive path is configured to provide builders with options among items that provide roughly equivalent performance. In the case of ventilation, a central fan integrated system (i.e., a supply duct connected to the return trunk of the central air handler that relies on the air handler motor to deliver outdoor air) has much higher energy use than an exhaust-only system and should be modeled in the performance or ERI path to account for energy use associated with operation beyond “free” heating or cooling cycles. The major software programs are able to model such systems and account for their energy use. Following is a table showing the annual energy cost of operating a central fan integrated system versus a minimally code compliant exhaust-only system for a typical single-family home with a ventilation rate of 75 cfm. Annual energy cost of the CFI system ranges from $84 to $241 more than the exhaust-only system. Simulations were conducted in REM/Rate and are available here: https://www.dropbox.com/sh/yw3r9kwq9it4axg/AAD0N4lnij57N4qo2Tf60xcKa?dl=0.

<table>
<thead>
<tr>
<th>Climate Zone</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
</tr>
</thead>
<tbody>
<tr>
<td>Additional Annual Energy Cost of CFI System Versus Code-Minimum Exhaust System</td>
<td>$241</td>
<td>$183</td>
<td>$135</td>
<td>$95</td>
<td>$84</td>
<td>$100</td>
<td>$107</td>
<td>$131</td>
</tr>
</tbody>
</table>

Assumptions for the “typical” home:

– Single family, detached, 2018 IECC compliant
– 2376 ft², 4 bed (CZ 1-3); 3564 ft², 4 bed (CZ 4-8)
– DUV: 75 cfm
– Air sealing: 5ACH50 (CZ 1-2); 3 ACH50 (CZ 3-8)
– Heating/cooling: 80 AFUE furnace, 13 or 14 SEER AC, BLDC motor (ECM)

Software: REM/Rate v15.5

Energy prices: $0.1284/kWh; $1.307/therm

Cost Impact: The code change proposal will not increase or decrease the cost of construction. Where central fan integrated systems are prescribed in homes not currently complying with the performance or ERI path, additional costs will be required to comply with such paths. If the builder wishes to remain within the prescriptive path, other options include: specifying central fan integrated systems that use an exhaust fan to provide ventilation when there is a call for ventilation but no call for heating or cooling (such systems are commercially available for ~$140 premium versus a CFI system), or specifying an exhaust or balanced ventilation system instead of a CFI system. Specification of an exhaust ventilation systems instead of a CFI system would be expected to reduce the first cost of the ventilation system.
2018 International Energy Conservation Code

Revise as follows:

R403.6 (IRC N1103.6) Mechanical ventilation (Mandatory). The building shall be provided with ventilation that complies with the requirements of the International Residential Code or International Mechanical Code, as applicable, or with other approved means of ventilation. Outdoor air intakes and exhausts shall have automatic or gravity dampers that close when the ventilation system is not operating.

Add new text as follows:

R403.6.1 (IRC N1103.6.1) Heat or Energy Recovery Ventilation (Prescriptive). Dwelling units shall be provided with a heat recovery or energy recovery ventilation system in climate zones 7 and 8. The system shall be balanced with a minimum sensible heat recovery efficiency of 65% at 32°F (0°C) at a flow greater than or equal to the design airflow.

Reason: A recent study conducted by Pacific Northwest National Laboratory showed HRVs and ERVs to be cost effective in climate zones 7 and 8, with annual energy savings from $138 to $233 on an initial investment of ~$1500 installed (corresponding to a first cost premium of ~$840 versus an exhaust only system and one entry-level bath fan; yielding simple paybacks of 4-6 years). This proposal is aligned with recent changes across most of Canada to require heat recovery ventilation for dwelling units. This proposal would require heat or energy recovery ventilators only for those dwelling units following the prescriptive path in the coldest climate zones, which represents a conservative improvement to the code.


Cost Impact: The code change proposal will increase the cost of construction
The first cost of construction (including costs for appliance, equipment, and installation) is expected to increase by ~$830 compared to an exhaust-only system. Based on PNNL's projected energy savings, this will be be recovered quickly, within 4-6 years. Assuming the $830 is financed in a traditional, 30-year mortgage at 4%, the annual energy savings of $138-$233 would generate $90 - $185 per year in cash flow for the home owner.

Proposal # 5673
Proponent: Mike Moore, Newport Ventures, representing Broan-NuTone (m_moore@newportventures.net)

2018 International Energy Conservation Code

R403.6.1 (IRC N1103.6.1) Whole-house mechanical ventilation system fan efficacy. Fans used to provide whole-house mechanical ventilation shall meet the efficacy requirements of Table R403.6.1.

Exception: Where an air handler that is integral to tested and listed HVAC equipment is used to provide whole-house mechanical ventilation, the air handler shall be powered by an electronically commutated motor.

Add new text as follows:

R403.6.2 (IRC N1103.6.2) Testing. Whole-house mechanical ventilation systems and outdoor air mechanical ventilation systems shall be tested and verified to provide the minimum ventilation flow rates required by Section R403.6. Testing shall be performed according to the ventilation equipment manufacturer’s instructions, or by using a flow hood, flow grid, or other airflow measuring device at the mechanical ventilation fan’s inlet terminals or grilles, outlet terminals or grilles or in the connected ventilation ducts. Where required by the code official, testing shall be conducted by an approved third party. A written report of the results of the test shall be signed by the party conducting the test and provided to the code official.

Reason: If installed incorrectly, whole-house mechanical ventilation systems can fail to deliver the minimum outdoor air needed to provide acceptable indoor air quality. A recent study in Florida* found that only three of 21 whole house mechanical ventilation systems had a flow rate near the design level. Because these systems perform a vital function in supporting building durability and occupant health, these systems should be verified for flow when installed. This requirement and text are aligned with ASHRAE 62.2, Ventilation and Acceptable Indoor Air Quality in Residential Buildings.


Cost Impact: The code change proposal will increase the cost of construction. Testing the airflow of a whole house mechanical ventilation system should take about 15-20 minutes. Assuming a skilled labor rate of $35/hr, the incremental cost for the test is estimated at $9-$12. The test can be completed by the same technician performing the blower door test. Also, there is no requirement for a third party to conduct the test, which can help moderate costs.
RE141-19
IECC: R403.6.2 (IRC N1103.6.3) (New)

Proponent: Aaron Gary, representing Self (aaron.gary@texenergy.org)

2018 International Energy Conservation Code

Add new text as follows:

R403.6.2 (IRC N1103.6.3) Testing (Mandatory) The fans used to provide whole-dwelling mechanical ventilation shall be tested according to the manufacturer’s instructions or RESNET/ICC 380. Testing shall be conducted by an approved third party. A written report of the results of the test shall be signed by the party conducting the test and provided to the code official.

Reason: Much blood has been spilled debating the appropriate amount of outdoor air that should be introduced into a dwelling via mechanical ventilation. While all this focus has been applied to the design calculations, much less has been turned to the actual air that is delivered by these systems. In my experience as a 3rd party verifier and HVAC contractor, the amount of air that is actually being delivered is as crucial as selecting the right design and equipment.

The commissioning of these systems is simply not required by Code and therefore it is not happening for a majority of Code dwellings. When more outdoor air is provided than intended it can overwhelm the right-sized (R403.7) heating and cooling equipment’s ability to process this air. The impact is human comfort complaints, potential moisture issues in humid climates, and lost energy efficiency.

Further, 3rd party verification and testing of the mechanical ventilation system is already part of the ERI path through its inclusion in ANSI/RESNET/ICC 301. It is not required however in the Prescriptive or Performance paths.

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

This proposal will increase the cost of construction for dwellings following the Prescriptive and Performance paths through the IECC not through additional or change in product but by requiring additional testing similar to Air Leakage testing (R402.4) and Duct Leakage testing (R403.3.3). This proposal will not increase the cost of construction for dwellings following the ERI path through the IECC as this test is already mandatory under ANSI/RESNET/ICC 301.

Proposal # 5545
RE142-19
IECC: R403.6.2 (IRC N1103.6.2) (New)

Proponent: Darren Meyers, P.E., International Energy Conservation Consultants LLC, representing Self (dmeyers@ieccode.com)

2018 International Energy Conservation Code
Add new text as follows:

R403.6.2 (IRC N1103.6.2) Airflow measurement. The airflow rate required is the quantity of outdoor ventilation air supplied and/or indoor air exhausted by the whole-house mechanical ventilation system installed, and shall be measured using a calibrated flow hood, flow grid, or other airflow measuring device. Ventilation airflow of systems with multiple operating modes shall be tested in all modes of operation designed to meet Section R403.6. Where required by the code official, testing shall conducted by an approved third party. A written report of the results of the test, indicating the verified airflow rate, shall be signed by the party conducting the test and provided to the code official.

Reason: The proposal adds a provision establishing the "measurement" of airflow associated with the central energy-using system of the home, its heating ventilation and air-conditioning system. The language, while derived from the provisions of ASHRAE Standard 62.2-2016, is written in useable, understandable and enforceable, mandatory language.

Bibliography:

Cost Impact: The code change proposal will increase the cost of construction
IECC LLC has experience with the implementation training and technical support activities associated with State Energy Offices, State Fire Marshall's Offices and Departments of Housing, Buildings and Construction for 2009 and 2012 IECC adoptions in Iowa, the 2009 and 2012 IECC adoptions in Kentucky, the 2012, 2015 and 2018 adoptions in Illinois and more recently the 2015 and 2018 adoptions throughout the greater Nashville, TN metro community. In conducting these activities, it is common to solicit, discuss and evaluate the pricing structures available in the residential housing sector. The building diagnostic services discussed include a code-mandated blower door pressure test, a code-mandated duct pressure leakage test (pending location of ductwork), as well as services less commercialized in the residential housing sector; infrared thermography and HVAC ventilation system airflow validation. It is common that when a code mandated test is "bundled" with one of the other home diagnostic services these price points are discounted.

Proposal # 5575
RE143-19

IECC: R403.7 (IRC N1103.7), ACCA Chapter 6 (IRC Chapter 44)

Proponent: David Bixby, representing Air Conditioning Contractors of America

2018 International Energy Conservation Code

Revise as follows:

R403.7 (IRC N1103.7) Equipment sizing and efficiency rating (Mandatory). Heating and cooling equipment shall be sized in accordance with ACCA Manual S based on building loads calculated in accordance with ACCA Manual J or other approved heating and cooling calculation methodologies. New or replacement heating and cooling equipment shall have an efficiency rating equal to or greater than the minimum required by federal law for the geographic location where the equipment is installed. Minimum criteria for the proper design, equipment selection, installation, and commissioning of HVAC systems shall comply with ACCA 5 QI.

Add new standard(s) as follows:

ANSI/ACCA 5 QI -2010: HVAC Quality Installation Specifications

Reason: ANSI/ACCA 5 QI Standard (HVAC Quality Installation Specification) covers the initial HVAC system design, including system sizing, equipment selection, duct sizing, start-up and commissioning. It was developed by a broad coalition of industry stakeholders and is available for free download (www.acca.org/quality).

In September 2014, the U.S. National Institute of Standards and Technology (NIST) published, “Sensitivity Analysis of Installation Faults on Heat Pump Performance.” This report presents evidence that non-compliance with the ANSI/ACCA 5 QI Standard results in quantifiable increases in energy usage and operating costs. The NIST report demonstrated that the increased energy consumption can be greater than 50% when multiple deficiencies (e.g., duct leakage, low refrigerant charge, equipment oversizing, airflow, etc.) are encountered. While the industry focuses on equipment efficiency, the real efficiency of the system (installed efficiency) is determined by its proper design, installation, and commissioning.

The ACCA 5 QI Standard has been adopted by the Consortium for Energy Efficiency (CEE; a consortium of utilities with programmatic efforts in energy efficiency) as its definition for the minimum requirements for HVAC installations. In addition, the “HVAC Commissioning Checklist” for EPA Energy Star® certified homes, Green Building Communities, and HERS Rating is embodied in the requirements of the ANSI/ACCA 5 QI protocol, thereby insuring the performance of HVAC systems in new homes.

Cost Impact: The code change proposal will not increase or decrease the cost of construction

Cost of construction will be unaffected other than the extra time to properly design, size and install an HVAC system according to minimum industry accepted practices.

Proposal # 4813
2018 International Energy Conservation Code

Revise as follows:

R403.12 (IRC N1103.12) Residential pools and permanent residential spas (Mandatory). Residential swimming pools and permanent residential spas that are accessory to detached one- and two-family dwellings and townhouses three stories or less in height above grade plane and that are available only to the household and its guests shall be in accordance with APSP 15.

Reason: This section provides a reference to a specific standard with no alternative provided. The section provides no metrics or values that can be used for calculations for trade-offs. Additionally, both R403.10 and R403.11, which address similar subjects, are labeled mandatory and there is no reason for this to be inconsistent.

Note, the SEHPCAC has a proposal to eliminate use of the labels "prescriptive" and "mandatory" in favor of a tabular method of identifying non-tradeable requirements. If that proposal is successful ICC staff have stated that sections being individually approved as "mandatory" will instead have their respective section numbers added to the new C407.2 table of requirements that are non-tradeable in the performance path.

This proposal is submitted by the ICC Sustainable, Energy and High Performance Code Action Committee (SEHPCAC). The SEHPCAC was established by the ICC Board of Directors to pursue opportunities to improve and enhance International Codes with regard to sustainability, energy and high performance as it relates to the built environment included, but not limited to, how these criteria relate to the International Green Construction Code (IgCC) and the International Energy Conservation Code (IECC). In 2018-2019, the SEHPCAC has held five two- or three-day open meetings and numerous workgroup calls, to discuss and debate proposed changes and public comments. Attendees at the meetings and calls included members of the SEHPCAC as well as any interested parties. Related documentation and reports are posted on the SEHPCAC website at: http://www.iccsafe.org/cs/SEHPCAC/Pages/default.aspx

Cost Impact: The code change proposal will not increase or decrease the cost of construction

This code change proposal does not add to nor detract from design or construction requirements.
Proponent: Lauren Urbanek, representing Natural Resources Defense Council (lurbanek@nrdc.org)

2018 International Energy Conservation Code

Add new definition as follows:

**DIMMER. (IRC N1101.6).** A control device that is capable of continuously varying the light output and energy use of light sources.

Revise as follows:

**HIGH-EFFICACY LAMPS. (IRC N1101.6).** Compact fluorescent lamps, light-emitting diode (LED) lamps, T-8 or smaller diameter linear fluorescent lamps, or other lamps with an efficacy of not less than the following: 70 lumens per watt.

1. 60 lumens per watt for lamps over 40 watts.
2. 50 lumens per watt for lamps over 15 watts to 40 watts.
3. 40 lumens per watt for lamps 15 watts or less.

Add new definition as follows:

**OCCUPANT SENSOR CONTROL. (IRC N1101.6).** An automatic control device or system that detects the presence or absence of people within an area and causes lighting, equipment or appliances to be regulated accordingly.

Revise as follows:

**R404.1 (IRC N1104.1) Lighting equipment (Mandatory).** Not less than 90 percent of the permanently installed lighting fixtures shall contain only high-efficacy lamps.

Add new text as follows:

**R404.2 (IRC N1104.2) Lighting Controls (Mandatory).** Permanently installed lighting fixtures shall be controlled with either a dimmer, an occupant sensor control, or other control that is installed or built into the fixture.

**Exception:** Lighting controls shall not be required for the following:

1. Bathrooms
2. Hallways
3. Exterior lighting fixtures
4. Lighting designed for safety or security

**Reason:** The purpose of this code change proposal is to increase lighting efficiency to better align with the current lighting market and upcoming changes to lighting standards.

DOE projects that light-emitting diode (LED) lighting will represent about half of the market share in 2020, and nearly 85% of the market share by 2030[1]. Goldman Sachs projects an even faster uptake of LEDs, projecting a full market penetration by the early 2020s[2]. The current definition of a “high efficacy lamp” in the energy code is outdated: it was added to the code in 2009, when LED market share was close to zero, and has not been updated since then. In fact, the definition no longer represents the “high efficacy” share of the market. New lighting standards will take effect in 2020 that will eliminate all bulbs on the market with efficiencies lower than 45 lumens per watt. Therefore, by the time the 2021 code is published, some of the bulbs currently defined by the IECC as “high efficacy” will be illegal to sell. Given these market and standard changes, the definition must be updated to remain relevant.

Once the updated federal standard takes effect, the baseline, least-efficient bulb on the market will no longer be an incandescent or even a halogen, but a compact fluorescent light bulb. In many cases, LEDs are close in price to – or even cheaper than - CFL alternatives while being a clearly superior product. CFLs contain mercury, are slow to come to full light, and few models are dimmable. In contrast, LEDs come in a wide range of light outputs, bulb shapes, color temperatures, socket types, do not contain mercury, and the vast majority of models are dimmable. Virtually all LEDs on the market today meet the 70 lumens per watt requirement specified in this proposal.

The table below summarizes a recent Home Depot search for a dimmable 60-watt equivalent bulb, one that gives off approximately 800 lumens of light. The LED bulb is significantly more efficient and longer-lasting than the CFL or halogen option. Recent searches found that sale prices of LED bulbs are often even lower than a halogen equivalent. Note that the CFL bulb is not dimmable; there was no equivalent dimmable CFL option. A separate search for dimmable CFL bulbs[3] shows that they are in the range of at least $7 per bulb and not widely available. The halogen option will not be legal to sell starting January 1, 2020.
<table>
<thead>
<tr>
<th>Lighting Technology</th>
<th>Brand</th>
<th>Cost per Bulb</th>
<th>Lumens Per Watt</th>
<th>Estimated Annual Energy Cost</th>
<th>Lifetime</th>
<th>Dimmable?</th>
</tr>
</thead>
<tbody>
<tr>
<td>LED</td>
<td>Philips[4]</td>
<td>$1.54 (sale price)</td>
<td>84</td>
<td>$0.84</td>
<td>22 years</td>
<td>Yes</td>
</tr>
<tr>
<td></td>
<td></td>
<td>$3.08 (full price)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CFL</td>
<td>EcoSmart[5]</td>
<td>$1.49</td>
<td>64</td>
<td>$1.69</td>
<td>9 years</td>
<td>No</td>
</tr>
<tr>
<td>Halogen</td>
<td>Westinghouse[6]</td>
<td>$2.10</td>
<td>18.1</td>
<td>$5.06</td>
<td>0.9 years</td>
<td>Yes</td>
</tr>
</tbody>
</table>

The proposal also requires lighting controls, in the form of either a dimmer, occupancy control, or other such control (such as an automatic daylight sensor). Both dimmers and occupancy controls will save even more energy. Dimmers can reduce energy use by about 20%, while occupancy sensors reduce wasted energy by around 30%[7]. These controls are essentially permanent, with an extremely long lifetime. Connected occupancy controls, such as those in use with a home automation system, can add value and convenience to homeowners, as well.


Cost Impact: The code change proposal will increase the cost of construction. This proposal will increase the cost of construction due to the increased cost of dimmer switches or occupancy controls. However, there is little, if any, incremental cost to move from CFL to LED bulbs even today, and the costs of this technology will continue to decrease. Given the change in technology and the improved federal standards, by the time the 2021 code is adopted, there may be no incremental cost to purchase a LED bulb.
Compared: Battery-Electric 73%, Hydrogen 22%, ICE 13%.

The full lifecycle of fuel production and use, the average EV consumes less than half the energy per vehicle mile traveled. EV fuel economy is, on average, more than three times more efficient than conventional gasoline-fueled counterparts. Even when compared over increased adoption of EVs will have a positive effect on overall U.S. household energy spending and carbon emissions. In terms of energy savings, future Level 2 charger installations, which will eventually become practically ubiquitous, at a much lower cost.

Typical EV in 10 hours or less, will be a financial burden on homeowners. Adding a requirement for EV-ready parking spaces to the code will facilitate which require an additional 240-volt circuit. The cost of retrofitting a home to accommodate a Level 2 charger, which can recover the full range of a typical EV in 10 hours or less, will be a financial burden on homeowners. Adding a requirement for EV-ready parking spaces to the code will facilitate which will be mostly installed in homes, will be required by 2025 to support a fleet of seven million EVs. See EEI and IEI, “Plug-in Electric Vehicle Sales Forecast Through 2025 and the Charging Infrastructure Required.” In the near term this will likely involve the installation of Level 2 chargers, which require an additional 240-volt circuit. The cost of retrofitting a home to accommodate a Level 2 charger, which can recover the full range of a typical EV in 10 hours or less, will be a financial burden on homeowners. Adding a requirement for EV-ready parking spaces to the code will facilitate future Level 2 charger installations, which will eventually become practically ubiquitous, at a much lower cost.

Increased adoption of EVs will have a positive effect on overall U.S. household energy spending and carbon emissions. In terms of energy savings, EV fuel economy is, on average, more than three times more efficient than conventional gasoline-fueled counterparts. Even when compared over the full lifecycle of fuel production and use, the average EV consumes less than half the energy per vehicle mile traveled. See InsideEVs, “Efficiency Compared: Battery-Electric 73%, Hydrogen 22%, ICE 13%,” available at https://insideevs.com/efficiency-compared-battery-electric-73-hydrogen-
and Argonne National Laboratory, “Greenhouse Gases, Regulated Emissions, and Energy use in Transportation Model,” available at https://greet.es.anl.gov/index.php. NRDC and EPRI found that if 50 percent of personal vehicle miles traveled were powered by electricity in 2050, the U.S. would realize annual emissions reductions of 550 million metric tons of carbon dioxide. See NRDC, “Study: Electric Vehicles Can Dramatically Reduce Carbon Pollution from Transportation, and Improve Air Quality,” available at https://www.nrdc.org/experts/luke-tonachel/study-electric-vehicles-can-dramatically-reduce-carbon-pollution. The ideal solution would get this code change in place by the time adoption rates are expected to accelerate, which would help facilitate adoption of EVs and therefore lead to more efficient energy consumption and lower household carbon emissions.


Cost Impact: The code change proposal will increase the cost of construction
The additional branch circuit and associated wiring and conduit required to make parking spaces EV-ready will incrementally increase the cost of construction. But the cost of a retrofit to add the electrical panel capacity for a common Level 2 charger will be much higher—up to $2,000. See Realtor.com, “Electric Car Charger Installation in Your Home: True Costs—and What You Need to Know,” available at https://www.realtor.com/advice/home-improvement/installing-electric-vehicle-charger/.
IECC: R404.2 (IRC N1104.2) (New), R404.2.1 (IRC N1104.2.1) (New), R404.2.2 (IRC N1104.2.2) (New), R404.2.3 (IRC N1104.2.3) (New)

Proponent: Lauren Urbanek, representing Natural Resources Defense Council (lurbanek@nrdc.org)

2018 International Energy Conservation Code

Add new text as follows:

R404.2 (IRC N1104.2) Electric readiness (Mandatory) Systems using gas or propane water heaters, dryers, or conventional cooking equipment to serve individual dwelling units shall comply with the requirements of Sections R404.2.1 and R404.2.2. All water heating systems shall comply with Section R404.2.3.

R404.2.1 (IRC N1104.2.1) Receptacle. A dedicated 125-volt, 20-amp electrical receptacle that is connected to the electric panel with a 120/240 volt 3 conductor, 10 AWG copper branch circuit, shall be provided within 3 feet from each gas or propane water heater, dryer, and conventional cooking equipment, accessible with no obstructions.

R404.2.2 (IRC N1104.2.2) Electrification-ready circuits. Both ends of the unused conductors shall be labeled with the word “SPARE” and be electrically isolated. A single pole circuit breaker space shall be reserved in the electrical panel adjacent to each circuit breaker for the branch circuit and labeled with the words “FUTURE 240V USE.”

R404.2.3 (IRC N1104.2.3) Water heater space. An indoor space that is at least 3 feet by 3 feet by 7 feet high shall be available within 3 feet of the water heater.

Exception: The water heater space requirement does not need to be met where a heat pump water heater is installed.

Reason: This proposal enhances customer choice by making it easy for homeowners to choose either electric or gas appliances and water heating equipment. By ensuring that a home built with gas or propane can easily accommodate future electric appliances and equipment, this proposal protects homeowners from future costs, should natural gas become less affordable or even unavailable over the life of the building. As the electric grid becomes cleaner, and high-efficiency electric heat pump technology increasingly offers utility bill and pollution reduction benefits over gas, more customers may want to transition from natural gas to electric space and water heating. Federal, state, and local environmental and public health policies may also encourage, or even require the transition in some areas over the life of the building. Electric-ready requirements will protect customers from potential high retrofit costs.

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

The cost of meeting these electric-ready requirements when the house is being built, walls are open, and the trades are already on-site, is marginal. In comparison, the cost of retrofitting a building for these requirements can be orders of magnitude higher and act as a barrier for the homeowner to choose electric appliances. Not making new buildings electric-ready would leave homeowners exposed to potentially high retrofit costs in the future and will greatly inhibit customer choice.
2018 International Energy Conservation Code

Add new text as follows:


**Exceptions:**

1. Solar-powered lamps not connected to any electrical service.
2. Luminaires controlled by a motion sensors.

**Reason:** The IECC does not have any specific requirements for exterior lighting for residential buildings. This may not be a significant issue for single-family homes, duplexes and townhomes, but it is quite significant for Type-R occupancies like multifamily that are far more likely to have parking lots and other exterior lighting like their counterparts subject to the commercial code. A 4-story multifamily building with exactly the same systems and layout would therefore be subject to exterior lighting requirements while a 3-story variation would not. This creates a loophole in the code for low-rise R-occupancies.

This proposal directs exterior lighting for these occupancies to the commercial code and its LPD requirements. Small R-occupancy buildings are little different than small commercial buildings which are already subject to those requirements. The proposal exempts solar-powered lighting and any lighting controlled by a motion sensor.

When applied to the low-rise multifamily prototype developed by Pacific Northwest National Laboratories for the code determination studies, this requirement saved up to 0.5% (based on climate zone) whole building energy over the 2015 IECC. Since both 2018 and 2015 lack exterior lighting requirements, this is a reasonable approximation of savings.

**Cost Impact:** The code change proposal will increase the cost of construction. This will increase the cost of construction. However, the proposal refers only R-occupancies to the existing commercial exterior lighting requirements, which already cover smaller commercial buildings.

For example, a base light fixture cost for a 70 W halogen fixture is $118.00 (https://www.lightingsupply.com/stonco-sla71mal-6) and the cost for an enhanced 80 W LED light fixture that will meet the proposed efficacy requirements is $158.33 (https://www.lightingsupply.com/best-lighting-products-ledmpal80-1-5k)

Proposal # 5187
RE149-19
IECC: R404.2 (IRC N1104.2) (New)

Proponent: Marilyn Williams, representing National Electrical Manufacturers Association (mar_williams@nema.org)

2018 International Energy Conservation Code
Add new text as follows:

R404.2 (IRC N1104.2) Exterior lighting controls Where the total permanently installed Exterior lighting power is greater than 30 watts, the exterior lighting permanently mounted to a residential building, or to other buildings on the same lot, shall comply with the following:

1. Lighting shall be controlled by a manual on and off switch which permits automatic shut off actions.
2. Lighting shall automatically turn off when daylight is present during the daytime and satisfies the lighting needs.
3. Lighting shall automatically turn off by time-switch control or when activity has not been detected for 15 minutes or more.
4. Controls that override automatic shut off actions shall note be allowed unless the override automatically returns automatic control to its normal operation within six twenty-four hours.

Reason: The increase in construction cost is due to the addition of a simple photocell or use of exterior lighting fixtures with integral photocell. These are inexpensive and readily available in many options at retailers and electrical distributors. Photocell costs are often under $10. Exterior light fixtures with integral photocell (and often including a motion detector), are available for a total packaged cost from the sub $20 range, up to many times this cost based the fixture style, grade and aesthetics. The added cost of the controls is typically minimal, or an inseparable option included with the exterior lighting fixture altogether. The 2014 CEE report “Lighting Controls Market Characterization Report”, identifies the use of a photosensor or timer can save, on the average, 15 up to 60KWh per year, based on the efficacy of the light source that is controlled.

Cost Impact: The code change proposal will increase the cost of construction
The increase in construction cost is due to the addition of a simple photocell or use of exterior lighting fixtures with integral photocell. These are inexpensive and readily available in many options at retailers and electrical distributors. Photocell costs are often under $10. Exterior light fixtures with integral photocell (and often including a motion detector), are available for a total packaged cost from the sub $20 range, up to many times this cost based the fixture style, grade and aesthetics. The added cost of the controls is typically minimal, or an inseparable option included with the exterior lighting fixture altogether. The 2014 CEE report “Lighting Controls Market Characterization Report”, identifies the use of a photosensor or timer can save, on the average, 15 up to 60KWh per year, based on the efficacy of the light source that is controlled.
RE150-19
IECC: R406.2 (IRC N1106.2)

**Proponent:** Joel Martell, representing National Association of Home Builders (jmartell@nahb.org)

**2018 International Energy Conservation Code**

Revise as follows:

**R406.2 (IRC N1106.2) Mandatory requirements.** Compliance with this section requires that the provisions identified in Sections R401 through R404 indicated as “Mandatory” and Section R403.5.3 be met. The proposed total building thermal envelope UA which is sum of U-factor times assembly area, shall be greater than or equal to the building thermal envelope UA using the prescriptive U-factors from Table R402.1.2 multiplied by 1.15 in accordance with Equation 4-1, levels of efficiency and Solar Heat Gain Coefficients in Table 402.1.1 or 402.1.3 of the 2009 International Energy Conservation Code.

**Exception:** Supply and return ducts not completely inside the building thermal envelope shall be insulated to a R-value of not less than R-6.

\[
UA_{\text{Proposed design}} = 1.15 \times UA_{\text{Prescriptive reference design}} \tag{Equation 4-1}
\]

**Reason:** This proposal increases the flexibility of the thermal envelope minimums that are part of the ERI compliance path mandatory requirements. The minimum thermal envelope requirements are that of the 2009 IECC prescriptive table. While this could be considered a reasonable “backstop”, the flexibility it offers is minimal; for example both the 2009 and 2018 IECC require R-20 walls in climate zone 5 and because the 2009 IECC is the minimum, there is no ability to trade off wall insulation in climate zone 5, but wall insulation can be traded off in zones 3, 4, 7 & 8 since the wall insulation requirements increased from the 2009. This proposal preserves this “reasonable envelope” concept and applies it to the ERI, but, rather than pointing to the prescriptive tables in a previous version of the IECC, the thermal backstop becomes a percent UA trade-off. The UA calculation will be performed internally with the compliance software and will not require any additional information to be entered as all the necessary information is already entered (component area and U-factors/ R-values). This should not be problematic as it is already done for windows. This 15% will prevent installing single pane windows and significant reductions in the building envelope components.

**Cost Impact:** The code change proposal will not increase or decrease the cost of construction. The increased flexibility offered by this proposal will provide an opportunity for builders and designers to cost optimize an efficient home and potentially reduce the cost of construction.
RE151-19

IECC: R405.2 (IRC N1105.2), ICC Chapter 6 (IRC Chapter 44)

Proponent: William Fay, Energy-Efficient Codes Coalition, representing Energy-Efficient Codes Coalition (bfay@ase.org); Daniel Bresette, Alliance to Save Energy, representing Alliance to Save Energy (dbresette@ase.org); Maureen Guttman, BCAP-IBTS, representing BCAP-IBTS (mguttman@bcapcodes.org); Harry Misuriello, representing American Council for an Energy-Efficient Economy (misuriello@verizon.net)

2018 International Energy Conservation Code

Revise as follows:

R405.2 (IRC N1105.2) Mandatory requirements. Compliance with this section requires that the mandatory provisions identified in Section R401.2 be met. The building thermal envelope shall be greater than or equal to levels of efficiency and Solar Heat Gain Coefficients in Table R402.1.1 or R402.1.3 of the 2009 International Energy Conservation Code. Supply and return ducts not completely inside the building thermal envelope shall be insulated to an R-value of not less than R-6.

Add new text as follows:


Reason: The purpose of this code change is to help ensure long-term energy savings and occupant comfort by applying a reasonable, consistent minimum mandatory thermal envelope backstop across the IECC’s two performance-based compliance paths. Since 2015, the newest IECC compliance path, the Energy Rating Index (R406), has already included a minimum mandatory thermal envelope backstop based on the 2009 IECC prescriptive requirements. While a minimum backstop is most important for the ERI, it would also be useful if applied to the simulated performance alternative in Section R405. This proposal will accomplish this objective.

An important part of the logic behind the minimum thermal envelope requirements for the ERI applies to the performance path in Section R405 as well -- a well-built thermal envelope provides long-term energy savings and improved comfort for occupants over the lifetime of the home, and upgrades to the thermal envelope are easiest to incorporate (and most cost-effective) at construction. This is consistent with the intent of the IECC set forth in Section R101.3. Specifically, the IECC is intended to "regulate the design and construction of buildings for the effective use and conservation of energy over the useful life of each building." Regardless of the compliance option selected by the code user, the IECC should require a reasonable minimum level of performance by the home's permanent thermal envelope. As a result, this proposal would apply the same minimum mandatory requirements, including envelope requirements, to Section R405 compliance as currently apply to Section R406 compliance.

To our knowledge, the 2009 IECC backstop in Section R406.2 has been adopted by every state that has adopted the ERI as part of the 2015 or 2018 IECC. A trade-off backstop recognizes the crucial importance of a reasonably efficient thermal envelope, irrespective of the efficiency tradeoffs among various other building components. While we would prefer an even more robust backstop than the 2009 prescriptive requirements (such as the 2015 requirements, which were established in 2018 for ERI compliance that includes on-site generation), the 2009 requirements are at least a reasonable starting place and are consistent with the current backstop for ERI.

Cost Impact: The code change proposal will not increase or decrease the cost of construction

Because this proposal only establishes a trade-off backstop to an alternative compliance path and not a prescriptive code requirement (the prescriptive requirements are already much more efficient than the proposed new backstop levels), and because most homebuilders are likely already meeting or exceeding these requirements, we conclude that there will not necessarily be any cost impact.
### 2018 International Energy Conservation Code

Revise as follows:

**R405.1 (IRC N1105.1) Scope.** This section establishes criteria for compliance using simulated energy performance analysis. Such analysis shall include heating, cooling, mechanical ventilation and service water heating energy only. Devices or practices for which no credit is claimed and devices which are not installed shall not increase or decrease the proposed design energy use.

#### TABLE R405.5.2(1) [IRC N1105.5.2(1)]

**SPECIFICATIONS FOR THE STANDARD REFERENCE AND PROPOSED DESIGNS**

<table>
<thead>
<tr>
<th>BUILDING COMPONENT</th>
<th>STANDARD REFERENCE DESIGN</th>
<th>PROPOSED DESIGN</th>
</tr>
</thead>
<tbody>
<tr>
<td>Above-grade walls</td>
<td>Type: mass, where the proposed wall is a mass wall; otherwise, wood frame.</td>
<td>As proposed</td>
</tr>
<tr>
<td></td>
<td>Gross area: same as proposed.</td>
<td>As proposed</td>
</tr>
<tr>
<td></td>
<td>U-factor: as specified in Table R402.1.4.</td>
<td>As proposed</td>
</tr>
<tr>
<td></td>
<td>Solar absorptance = 0.75.</td>
<td>As proposed</td>
</tr>
<tr>
<td></td>
<td>Emittance = 0.90.</td>
<td>As proposed</td>
</tr>
<tr>
<td>Basement and crawl space walls</td>
<td>Type: same as proposed.</td>
<td>As proposed</td>
</tr>
<tr>
<td></td>
<td>Gross area: same as proposed.</td>
<td>As proposed</td>
</tr>
<tr>
<td></td>
<td>U-factor: as specified in Table R402.1.4, with the insulation layer on the interior side of the walls.</td>
<td>As proposed</td>
</tr>
<tr>
<td>Above-grade floors</td>
<td>Type: wood frame.</td>
<td>As proposed</td>
</tr>
<tr>
<td></td>
<td>Gross area: same as proposed.</td>
<td>As proposed</td>
</tr>
<tr>
<td></td>
<td>U-factor: as specified in Table R402.1.4.</td>
<td>As proposed</td>
</tr>
<tr>
<td>Ceilings</td>
<td>Type: wood frame.</td>
<td>As proposed</td>
</tr>
<tr>
<td></td>
<td>Gross area: same as proposed.</td>
<td>As proposed</td>
</tr>
<tr>
<td></td>
<td>U-factor: as specified in Table R402.1.4.</td>
<td>As proposed</td>
</tr>
<tr>
<td>Roofs</td>
<td>Type: composition shingle on wood sheathing.</td>
<td>As proposed</td>
</tr>
<tr>
<td></td>
<td>Gross area: same as proposed.</td>
<td>As proposed</td>
</tr>
<tr>
<td></td>
<td>Solar absorptance = 0.75.</td>
<td>As proposed</td>
</tr>
<tr>
<td></td>
<td>Emittance = 0.90.</td>
<td>As proposed</td>
</tr>
<tr>
<td>Attics</td>
<td>Type: vented with an aperture of 1 ft² per 300 ft² of ceiling area.</td>
<td>As proposed</td>
</tr>
<tr>
<td>Foundations</td>
<td>Type: same as proposed.</td>
<td>As proposed</td>
</tr>
<tr>
<td></td>
<td>Foundation wall area above and below grade and soil characteristics: same as proposed.</td>
<td>As proposed</td>
</tr>
<tr>
<td>Opaque doors</td>
<td>Area: 40 ft².</td>
<td>As proposed</td>
</tr>
<tr>
<td></td>
<td>Orientation: North.</td>
<td>As proposed</td>
</tr>
<tr>
<td></td>
<td>U-factor: same as fenestration as specified Table R402.1.4.</td>
<td>As proposed</td>
</tr>
<tr>
<td>Vertical</td>
<td>Total area² = (a) The proposed glazing area, where the proposed glazing area is less than 15 percent of the conditioned floor area</td>
<td>As proposed</td>
</tr>
<tr>
<td></td>
<td>(b) 15 percent of the conditioned floor area, where the proposed glazing area is 15 percent or more of the conditioned floor area.</td>
<td>As proposed</td>
</tr>
<tr>
<td>Tenestration other than opaque doors</td>
<td>Orientation: equally distributed to four cardinal compass orientations (N, E, S &amp; W).</td>
<td>As proposed</td>
</tr>
<tr>
<td>-------------------------------------</td>
<td>-----------------------------------------------------------------------------------------------</td>
<td>-------------</td>
</tr>
<tr>
<td></td>
<td>U-factor: as specified in Table R402.1.4.</td>
<td>As proposed</td>
</tr>
<tr>
<td></td>
<td>SHGC: as specified in Table R402.1.2 except for climate zones without an SHGC requirement, the SHGC shall be equal to 0.40.</td>
<td>As proposed</td>
</tr>
<tr>
<td></td>
<td>Interior shade fraction: 0.92 - (0.21 × SHGC for the standard reference design).</td>
<td>Interior shade fraction: 0.92 - (0.21 × SHGC as proposed)</td>
</tr>
<tr>
<td></td>
<td>External shading: none.</td>
<td>As proposed</td>
</tr>
<tr>
<td>Skylights</td>
<td>None.</td>
<td>As proposed</td>
</tr>
<tr>
<td>Thermally isolated sunrooms</td>
<td>None.</td>
<td>As proposed</td>
</tr>
<tr>
<td><strong>Air exchange rate</strong></td>
<td>The air leakage rate at a pressure of 0.2 inch w.g. (50 Pa) shall be:</td>
<td>The measured air exchange rate. The mechanical ventilation rate shall be in addition to the air leakage rate and shall be as proposed.</td>
</tr>
<tr>
<td></td>
<td>5 air changes per hour. Climate Zones 3 through 8: 3 air changes per hour.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>The mechanical ventilation rate shall be in addition to the air leakage rate and shall be the same as in the proposed design, but not greater than (0.01 \times CFA + 7.5 \times (N_{br} + 1))</td>
<td></td>
</tr>
<tr>
<td></td>
<td>where:</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(CFA = \text{conditioned floor area, ft}^2).</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(N_{br} = \text{number of bedrooms.})</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Energy recovery shall not be assumed for mechanical ventilation.</td>
<td></td>
</tr>
<tr>
<td>Mechanical ventilation</td>
<td>Where mechanical ventilation is not specified in the proposed design:</td>
<td>As proposed</td>
</tr>
<tr>
<td></td>
<td>NoneWhere mechanical ventilation is specified in the proposed design, the annual vent fan energy use, in units of kWh/yr, shall equal:</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(\left(\frac{1}{\epsilon_f}\right) \times \left[0.0876 \times CFA + 65.7 \times (N_{br} + 1)\right])</td>
<td></td>
</tr>
<tr>
<td></td>
<td>where:</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(\epsilon_f = \text{the minimum exhaust fan efficacy, as specified in Table R403.6.1, corresponding to a flow rate of } 0.01 \times CFA + 7.5 \times (N_{br} + 1))</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(CFA = \text{conditioned floor area, ft}^2).</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(N_{br} = \text{number of bedrooms.})</td>
<td></td>
</tr>
<tr>
<td>Internal gains</td>
<td>IGain, in units of Btu/day per dwelling unit, shall equal:</td>
<td>Same as standard reference design.</td>
</tr>
<tr>
<td></td>
<td>(17,900 + 23.8 \times CFA + 4,104 \times N_{br})</td>
<td></td>
</tr>
<tr>
<td></td>
<td>where:</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(CFA = \text{conditioned floor area, ft}^2).</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(N_{br} = \text{number of bedrooms.})</td>
<td></td>
</tr>
<tr>
<td>Internal mass</td>
<td>Internal mass for furniture and contents: 8 pounds per square foot of floor area.</td>
<td>Same as standard reference design, plus any additional mass specifically designed as a thermal storage element but not integral to the building envelope or structure.</td>
</tr>
<tr>
<td>Structural mass</td>
<td>For masonry floor slabs: 80 percent of floor area covered by R-2 carpet and pad, and 20 percent of floor directly exposed to room air.</td>
<td>As proposed</td>
</tr>
<tr>
<td></td>
<td>For masonry basement walls: as proposed, but with insulation as specified in Table R402.1.4, located on the interior side of the walls.</td>
<td>As proposed</td>
</tr>
<tr>
<td></td>
<td>For other walls, ceilings, floors, and interior walls: wood frame construction.</td>
<td>As proposed</td>
</tr>
<tr>
<td>Category</td>
<td>Details</td>
<td>As proposed</td>
</tr>
<tr>
<td>----------------------------------------------</td>
<td>---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
<td>---------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Heating systems</td>
<td>For other than electric heating without a heat pump: as proposed. Where the proposed design utilizes electric heating without a heat pump, the standard reference design shall be an air source heat pump meeting the requirements of Section C403 of the IECC—Commercial Provisions. Capacity: sized in accordance with Section R403.7.</td>
<td>As proposed</td>
</tr>
<tr>
<td>Cooling systems</td>
<td>As proposed. Capacity: sized in accordance with Section R403.7.</td>
<td>As proposed</td>
</tr>
<tr>
<td>Service water heating</td>
<td>As proposed. Use: same as proposed design. Use, in units of gal/day = 30 + (10 × N_b) where: N_b = number of bedrooms.</td>
<td>As proposed</td>
</tr>
<tr>
<td>Thermal distribution systems</td>
<td>Duct insulation: in accordance with Section R403.3.1. A thermal distribution system efficiency (DSE) of 0.88 shall be applied to both the heating and cooling system efficiencies for all systems other than tested duct systems. Exception: For nonducted heating and cooling systems that do not have a fan, the standard reference design thermal distribution system efficiency (DSE) shall be 1. For tested duct systems, the leakage rate shall be 4 cfm (113.3 L/min) per 100 ft² (9.29 m²) of conditioned floor area at a pressure of differential of 0.1 inch w.g. (25 Pa).</td>
<td>Duct insulation: as proposed. As tested or, where not tested, as specified in Table R405.5.2(2)</td>
</tr>
<tr>
<td>Thermostat</td>
<td>Type: Manual, cooling temperature setpoint = 75°F; heating temperature setpoint = 72°F. Same as standard reference design.</td>
<td>Same as standard reference design.</td>
</tr>
<tr>
<td>Lighting</td>
<td>kWh/year = 0.61 w/ft² · CFA Lighting power density (LPD) = 0.61 w/ft² CFA = Conditioned floor area (ft²) kWh/year = 1 kWh per installed watt LPD w/ft² = as proposed</td>
<td>Same, or</td>
</tr>
<tr>
<td>Refrigerator</td>
<td>650 kWh/year</td>
<td>As proposed</td>
</tr>
<tr>
<td>Clothes Washer</td>
<td>500 kWh/year</td>
<td>As proposed</td>
</tr>
<tr>
<td>Dishwasher</td>
<td>300 kWh/year</td>
<td>As proposed</td>
</tr>
<tr>
<td>Drain Water Heat Recovery</td>
<td>No drain water heat recovery</td>
<td>Same, or Service water heating reduced by 25% of drain water heater efficiency</td>
</tr>
<tr>
<td>Ventilation</td>
<td>No balanced ventilation</td>
<td>Same, or 30% reduction in required rate with balanced ventilation per IRC Section 1505</td>
</tr>
<tr>
<td>Heat Recovery</td>
<td>No heat recovery</td>
<td>Same, or % heat recovery as reported by manufacturer</td>
</tr>
</tbody>
</table>
Onsite Renewables | No onsite renewables | Same, or
---|---|---
Onsite renewables shall reduce the proposed design energy use.

For SI: 1 square foot = 0.93 m², 1 British thermal unit = 1055 J, 1 pound per square foot = 4.88 kg/m², 1 gallon (US) = 3.785 L,

° C = (° F - 32)/1.8, 1 degree = 0.79 rad.

a. Where required by the code official, testing shall be conducted by an approved party. Hourly calculations as specified in the ASHRAE Handbook of Fundamentals, or the equivalent, shall be used to determine the energy loads resulting from infiltration.


c. Thermal storage element shall mean a component that is not part of the floors, walls or ceilings that is part of a passive solar system, and that provides thermal storage such as enclosed water columns, rock beds, or phase-change containers. A thermal storage element shall be in the same room as fenestration that faces within 15 degrees (0.26 rad) of true south, or shall be connected to such a room with pipes or ducts that allow the element to be actively charged.

d. For a proposed design with multiple heating, cooling or water heating systems using different fuel types, the applicable standard reference design system capacities and fuel types shall be weighted in accordance with their respective loads as calculated by accepted engineering practice for each equipment and fuel type present.

e. For a proposed design without a proposed heating system, a heating system having the prevailing federal minimum efficiency shall be assumed for both the standard reference design and proposed design.

f. For a proposed design home without a proposed cooling system, an electric air conditioner having the prevailing federal minimum efficiency shall be assumed for both the standard reference design and the proposed design.

g. For a proposed design with a nonstorage-type water heater, a 40-gallon storage-type water heater having the prevailing federal minimum energy factor for the same fuel as the predominant heating fuel type shall be assumed. For a proposed design without a proposed water heater, a 40-gallon storage-type water heater having the prevailing federal minimum efficiency for the same fuel as the predominant heating fuel type shall be assumed for both the proposed design and standard reference design.

h. For residences with conditioned basements, R-2 and R-4 residences, and for townhouses, the following formula shall be used to determine glazing area:

\[ AF = A_s \times FA \times F \]

where:

\( AF \) = Total glazing area.
\( A_s \) = Standard reference design total glazing area.
\( FA \) = (Above-grade thermal boundary gross wall area)/(above-grade boundary wall area + 0.5 \times below-grade boundary wall area).
\( F \) = (above-grade thermal boundary wall area)/(above-grade thermal boundary wall area + common wall area) or 0.56, whichever is greater.

where:

Thermal boundary wall is any wall that separates conditioned space from unconditioned space or ambient conditions. Above-grade thermal boundary wall is any thermal boundary wall component not in contact with soil. Below-grade boundary wall is any thermal boundary wall in soil contact. Common wall area is the area of walls shared with an adjoining dwelling unit.

\( L \) and \( CFA \) are in the same units.

i. **Lighting verification**. For installed lighting a fixture/lamp schedule for the watts by room shall be provided for the interior lighting. Lighting schedule shall be summed to compute the total proposed watts.

j. **Refrigerator verification**. The annual kWhr of refrigerators shall be as specified by the EnergyGuide label” with Subpart C, U.S. 16 CFR 305
(Effective January 1, 2021). Where there are multiple refrigerators, the annual kWh shall be summed.

k. Clothes washer verification. The annual kWh of clothes washers shall be as specified by the EnergyGuide label" with Subpart C, U.S. 16 CFR 305 (Effective January 1, 2021). Where there are multiple clothes washers, the highest kWh shall be used.

l. Dishwasher verification. The annual kWh of dishwashers shall be as specified by the EnergyGuide label" with Subpart C, U.S. 16 CFR 305 (Effective January 1, 2021). Where there are multiple dishwashers, the highest kWh shall be used.

m. Drain water heat recovery. Drain water heat recovery unit efficiency shall be in accordance with Section R403.5.4 This credit shall require a drain water heat recovery unit be installed on all showers.

n. Balanced ventilation verification. Ventilation shall be in accordance with IRC 1505 which allows a 30% reduction in ventilation rate. To receive this credit exhaust-only bath fans shall be on a 20-minute timer or other device that shuts off the bath fan when not in use.

o. Heat recovery verification. Heat recovery ventilation or energy recovery ventilation shall be a reduction in energy use as specified by the manufacturer.

p. On-site renewables verification. Energy from on-site renewables shall be a reduction in the residence’s energy use based on an approved calculation of on-site renewable energy production.

Reason: This code change proposal expands the performance calculation to include additional options for energy savings. In all cases these options are neutral if not taken, but offer credits if taken. This change specifies efficiency measures in a way that makes them enforceable. Multiple jurisdictions reduce specific IECC/IRC energy requirements because those requirements seem difficult for some situations. For example air tightness and specific insulation levels are reduced in many jurisdictions. This code change gives the code user new options to increase energy efficiency in one area to compensate for another area.

The options in this proposal were picked because they have significant impact, can be specified in simple terms, and can be specified based on existing tests or standards. The performance section user can use or not use any of these options. Options not used do not affect the performance calculation, because the standard reference design and the proposed design become the same.

The ERI already includes the items listed here. The performance calculation should also include those items.

Several measures of efficiency in this change are based on existing tests or labels. Clothes washer, refrigerator and dishwasher annual energy use is on the federally required label. These are the yellow Energy Guide labels.

Lighting:

Lighting power density (LPD) is a concept usually applied to commercial spaces. The LPD for the reference design was selected based on Table C405.3.2.1 in the commercial IECC. The reference design (base case) of 0.61 was the lowest LPD from several that were similar to residential space. The similar values were “Dormitory” at 0.61; “Multifamily” at 0.68; and “Hotel/Motel” is 0.75.

The proposed lighting annual energy use is calculated as hours of use times watts. An average use of 1000 hours per year (2.74 hours per day) is within the reported range for actual light use and is presumed. Based on this use per day the proposed lighting annual energy use is simply 1 kWh per watt of installed lighting.

Lighting wattage will need to be verifiable, as lighting savings are based on the watts of installed lighting. Code officials are unlikely to have the time to count watts in a house. A list of lighting by room would give enough detail to spot check one or more rooms in a house.

Refrigerator, Clothes Washer, and Dishwasher:

These appliances all required to have EnergyGuide labels by federal law. The EnergyGuide labels all have kWh/year on the label.

Drain water heat recovery:

The drain water heat recovery applies to showers. Showers average over 25% of the service hot water use in homes. The devices recover heat from water going down the drain water and use it to preheat the incoming water. The heat recovery of a unit is rated by tests in CSA B55.1, which is already required in the code. (Section R403.5.4).

Ventilation:

Balanced ventilation performs better, requires less ventilation and uses less energy. Approved group A code changes (M22 and RM22) specified
that balanced ventilation required 30% less ventilation, hence the 30% reduction in the performance calculation.

Overall, this proposed change allows residences to achieve the energy efficiency in the IECC/IRC in a variety of ways. It comes with the philosophy that the goal is to reduce energy use. However, there are many ways to achieve that energy efficiency and the code user should be given the flexibility to choose how to achieve energy efficiency.

The performance calculation should also account for heating, cooling, and water heating equipment efficiency. A separate change restores the performance calculation credit for higher efficiency heating, cooling and water heating equipment.

Reference standard.


The proposed lighting energy use is calculated as hours of use times watts. An average use of 1000 hours per year (2.75 hours per day) is within the reported range for actual light use and is presumed. The proposed lighting annual energy use is simply 1 kWh per watt of installed lighting.

Lighting wattage will need to be verifiable, as lighting savings are based on the watts of installed lighting. Code officials are unlikely to have the time to count watts in a house. A list of lighting by room would give enough detail to spot check one or more rooms in a house.

Refrigerator:

This will favor, but not require, refrigerators without though the door ice, with freezer on the top rather than side-to-side. These refrigerators use less energy.

Equipment verification:

One big issue with having options for more efficient equipment and devices is inspection and verification. The efficiency used must be easy to verify.

Overall, this proposed change allows residences to achieve the energy efficiency in the IECC/IRC in a variety of ways. It comes with the philosophy that the goal is to reduce energy use. However, there are many ways to achieve that energy efficiency and the code user should be given the flexibility to choose how to achieve energy efficiency.

Cost Impact: The code change proposal will not increase or decrease the cost of construction. This will offer options for achieving efficient homes. If anything options typically decrease costs.
RE153-19
IECC: R405.3

Proponent: Ted Williams, representing American Gas Association (twilliams@aga.org)

2018 International Energy Conservation Code

Revise as follows:

R405.3 (IRC N1105.3) Performance-based compliance. Compliance based on simulated energy performance requires that a proposed residence (proposed design) be shown to have an annual energy cost that is less than or equal to the annual energy cost of the standard reference design. Energy prices shall be taken from a source approved by the code official, such as the Department of Energy, Energy Information Administration's State Energy Data System Prices and Expenditures reports. Code officials shall be permitted to require time-of-use pricing in energy cost calculations.

Exception: The energy use based on source energy expressed in Btu or Btu per square foot of conditioned floor area shall be permitted to be substituted for the energy cost. The source energy multiplier for electricity shall be 3.16. The source energy multiplier 3.16 for electricity and 1.1 for fuels other than electricity shall be 1.1 or other multipliers for national or regional annual average energy consumption from nationally-recognized and validated data sources.

Reason: The proposed change is consistent with the proposed change to C407.3 and is based upon the source energy metric usage in Federal energy programs including Energy Star for Commercial Buildings and Home Energy Score. This revised exception provides the only means of assessing energy performance on fuel cycle energy consumption and ultimately carbon footprints since site energy metrics alone cannot account for these upstream energy system losses. In addition, the allowance in the proposed exception language for use of “other multipliers” addresses a persistent criticism of national average multipliers, which do not reflect regional or local mixes of renewable energy in meeting building demands, and encourages authorities having jurisdiction to use locally-relevant multipliers that are available from utilities and other sources. Also, greater usefulness of the exception is critical since the basic requirements of R405.3 focusing on energy cost is not consistent with the intent of the IECC as stated in R101.3, which addresses energy use and conservation, not energy cost.

Cost Impact: The code change proposal will not increase or decrease the cost of construction. The proposal would not increase the cost of construction since the proposal is for changes to an exception. If the use of source energy metrics allows more alternatives for achieving energy performance improvements, it may decrease construction costs ultimately.

Proposal # 5579
2018 International Energy Conservation Code

Add new text as follows:

R405.3 (IRC N1105.3) **Performance-based compliance.** Compliance based on simulated energy performance requires that a proposed residence (proposed design) be shown to have an annual energy cost that is less than or equal to the annual energy cost of the **standard reference design.** Energy prices shall be taken from a source approved by the code official, such as the Department of Energy, Energy Information Administration’s State Energy Data System Prices and Expenditures reports. **Code officials shall be permitted to require time-of-use pricing in energy cost calculations.**

**Exception:** The energy use based on site energy or source energy expressed in Btu or Btu per square foot of conditioned floor area shall be permitted to be substituted for the energy cost. The source energy estimate multipliers for energy sources shall be taken from Table R405.3.1.

<table>
<thead>
<tr>
<th>SOURCE ENERGY TYPE</th>
<th>ESTIMATED SOURCE MULTIPLIER#</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electricity, Imported, General Grid</td>
<td>2.61</td>
</tr>
<tr>
<td>Electricity, Imported, Local or National RPS</td>
<td>Greater of [2.61 x (1 - RPS%)] or 1.00</td>
</tr>
<tr>
<td>Electricity, Off-Site Delivered Renewable</td>
<td>1.00</td>
</tr>
<tr>
<td>On-Site Renewable Electricity, used by building or exported</td>
<td>1.00</td>
</tr>
<tr>
<td>On-Site Stored Renewable Electricity (used by building or exported)</td>
<td>1.00</td>
</tr>
<tr>
<td>Natural Gas, domestic, no flaring/venting</td>
<td>1.09</td>
</tr>
<tr>
<td>Natural Gas, domestic, with 20% flaring/venting</td>
<td>1.37</td>
</tr>
<tr>
<td>Natural gas, imported as LNG</td>
<td>1.25</td>
</tr>
<tr>
<td>Fuel Oil (1, 2, 4, 5, 6, Diesel, Kerosene), domestic</td>
<td>1.19</td>
</tr>
<tr>
<td>Fuel Oil, imported from overseas</td>
<td>1.45</td>
</tr>
<tr>
<td>Propane, Liquid Propane, domestic</td>
<td>1.15</td>
</tr>
<tr>
<td>Propane, Liquid Propane, domestic, with 20% flaring/venting</td>
<td>1.49</td>
</tr>
<tr>
<td>Steam, Non-Renewable</td>
<td>1.45</td>
</tr>
<tr>
<td>Steam, Renewable</td>
<td>1.00</td>
</tr>
<tr>
<td>Hot Water, Non-Renewable</td>
<td>1.35</td>
</tr>
<tr>
<td>Hot Water, Renewable</td>
<td>1.00</td>
</tr>
<tr>
<td>Chilled Water, Non-Renewable</td>
<td>1.04</td>
</tr>
<tr>
<td>Chilled Water, Renewable</td>
<td>1.00</td>
</tr>
<tr>
<td>Coal or Other, domestic</td>
<td>1.05</td>
</tr>
</tbody>
</table>

# Values represent averages for the United States.

**Reason:** The world of energy production and energy storage and choices of energy supply is changing rapidly. The current language is outdated and does not account for all of the changes going on and needs to be revised.

This proposal will make the provision more flexible for building designers, building owners, and code officials. By allowing the use of site energy, which was allowed in previous versions of the IECC, the performance path can be based on real measured data. By updating source energy estimates, there will be more information provided to code officials and building owners.

More buildings are producing and storing energy on-site, so it does not make technical or analytical sense to require the use of outdated “source energy” estimates.

**Site Energy**
Allowing the use of site energy is more appropriate for buildings that are producing or storing energy on-site. In the future, many buildings will be producing energy and storing energy, along with consuming energy. Building systems may be consuming energy that was produced from an off-site energy grid and/or produced from an on-site energy production system and/or delivered from an off-site energy storage system (e.g., a grid battery or EV battery) and/or delivered from an on-site energy storage system, (e.g., and battery or fuel storage tank or thermal energy storage system). At the same time, the building may be producing energy that is used by building equipment, sent to an on-site energy storage system, or exported to another building (or buildings) or to the energy grid.

In a letter to DOE, ASHRAE said:

"the Society believes that the multiple and varying weighting factors and algorithms required for estimating source energy conversions are often inconsistent and ultimately cloud and complicate understanding. Since source energy conversion factors vary widely from place to place and across time, the use of fixed national average conversion factors could lead to inconsistent estimates of consumption."

"Thus, in this case the best method for determining if a building is a NZEB is to look at the energy crossing the boundary at the site of the building; hence "site" energy is the best choice to use." (emphasis added)

Site energy was part of the exception for many years until it was removed. There are many reasons to allow site energy to be used as an alternative to source energy or energy costs:

- Site energy is an actual metric that can be measured and verified by code officials, while source energy is an estimate.

- Site energy information is credible, as it is shown on customers’ energy bills on a monthly basis and used in other consensus-based code documents, such as ASHRAE 90.1, use site energy metrics for efficiency requirements.

- DOE uses site energy information in many of its energy efficiency and energy consumption publications, such as the Residential Energy Consumption Survey. DOE uses site energy for its appliance energy efficiency standards program and the FTC uses site energy on the yellow EnergyGuide labels found on consumer appliances. EPA uses site energy to determine if an appliance or home qualifies for the Energy Star program.

- Site energy is reliable, since it can be measured by utilities, consumers, and independent 3 parties. In terms of energy efficiency upgrades, consumers rely on site energy information (amount used by older appliance or equipment compared to new appliance or equipment) to help them make energy efficiency decisions.

- Site energy is replicable, as the units of measurement (kWh, therms, gallons, Btu's) can be used throughout the United States and are familiar to consumers on their monthly energy bills. Source energy is not replicable, as different estimates must be used for different energy sources, and different entities can make different assumptions about upstream production and delivery of different energy sources.

- Site energy is transparent and easy to understand. It can be based on meter readings or DOE test procedures or FTC EnergyGuide labels or Energy Star labels. It is the metric that allows people to easily compare energy efficiency options in the marketplace. It is the metric that allows people to make good economic choices when faced with competitive alternatives.

**Source Energy Estimates**

There are many ways to estimate upstream energy losses. The energy production industry is very dynamic and subject to significant changes. In the United States in 2018, there was a record amounts of natural gas produced from hydraulic fracturing production techniques. In 2018, there was a record amount of oil produced and imported from oil sands production. In 2018, there was a record amount of electricity produced from renewable forms of energy and a record amount of electricity produced by combined-cycle natural gas turbines.

The values that are currently shown should be deleted and not used. The values shown are not consistent with values shown in other published documents. Many documents and articles have been published over the past several years with source energy estimates as shown in the bibliography. The current values in the IECC do not match and cannot be substantiated with any of these published documents.

Different fossil fuels have different upstream source estimates. In the current IECC, all fossil fuels are assumed to have the same multiplier. In other documents, there is a large and statistically significant variation in the upstream estimates that will have a significant impact on energy performance results. As one example, for fuel oil and propane, EPA’s Portfolio Manager uses a factor of 1.01 for both, while NREL used estimated values of 1.158 and 1.151, while IGCC 2015 uses 1.19 for fuel oil and 1.15 for propane. The use of 3.16 for electricity is overstated for many parts of the United States and does not account for significant regional differences or the increase in the use of renewable power generation and combined cycle gas.
turbines.

In other publications and web sites, the estimates for electricity are shown on a national basis, a regional basis, or a state by state basis. This is due to the variety of electric generation techniques which have upstream energy losses that can vary by orders of magnitude based on local conditions, regional conditions, physical location, season, month, week, or day, as well as hourly fluctuations in the amount of sunlight or wind speed.

The revisions to the values are based on reports published by the US Energy Information Administration, the US Department of Energy, the US Environmental Protection Agency, national labs, and other public sources of information. It is a technical fact that there are significant differences in terms of upstream estimates for electricity as well as fossil fuels. The new estimates provide more defensible and accurate estimates.

**Bibliography:**
- American Gas Association EA 2009-3 "A Comparison of Energy Use, Operating Costs, and Carbon Dioxide Emissions of Home Appliances" (October 2009)
- Environmental Protection Agency "Energy Star Performance Ratings Methodology for Incorporating Source Energy Use" (August 2009 and 2017 update)
- National Renewable Energy Laboratory NREL/TP-550-47246 "Building America Research Benchmark Definition" (January 2010)
- American Gas Association "Dispatching Direct Use", Table 1, (November 2015)

US Department of Energy "Accounting Methodology for Source Energy of Non-Combustible Renewable Electricity Generation" (October 2016)

**Cost Impact:** The code change proposal will not increase or decrease the cost of construction.

This proposal only provides another option for the simulation used for the performance path.
Proponent: Marilyn Williams, representing National Electrical Manufacturers Association (mar_williams@nema.org)

2018 International Energy Conservation Code
Revise as follows:

**R404.1 (IRC N1104.1) Lighting equipment (Mandatory).** Not less than 90 percent of the permanently installed lighting fixtures shall contain only high-efficacy lamps. Luminaires shall utilize lamps with an efficacy of at least 65 lumens-per-watt, or have a luminaire efficacy of at least 45 lumens-per-watt.
2018 International Energy Conservation Code

Revise as follows:

R405.3 (IRC N1105.3) Performance-based compliance. Compliance based on simulated energy performance requires that a proposed residence (proposed design) be shown to have an annual energy cost that is less than or equal to the annual energy cost of the standard reference design. Energy prices shall be taken from a source approved by the code official, such as the Department of Energy, Energy Information Administration's State Energy Data System Prices and Expenditures reports. Code officials shall be permitted to require time-of-use pricing in energy cost calculations.

Exception: The energy use based on source energy expressed in Btu or Btu per square foot of conditioned floor area shall be permitted to be substituted for the energy cost. The source energy multiplier for electricity shall be 3.16. The source energy multiplier for fuels other than electricity shall be 1.1.

Reason: There is only one metric that consumers are concerned with. That metric is cost. The IECC and its predecessor the model energy code traditionally relied on energy costs to demonstrate compliance. During the 2015 code cycle, this section added the current exception for the use of source energy as an alternative to cost.

Source energy is a relatively complex exercise used to estimate the approximate amount of raw energy consumed in the delivery of energy to ultimate customers. It is not a measurement nor a repeatable calculation across either geography or time.

Among its many limitations, source energy is particularly challenged when dealing with electricity as it treats electricity derived from renewables like solar and wind the same as electricity from an old coal fired generator.

The U.S. Department of Energy recognizes this absurdity – of treating wind the same as coal – and several years ago published a report on the topic. (SEE bibliography).

The overwhelming majority of jurisdictions using the IECC rely on cost.

There is no meaningful reason to keep the exception in the code and it should be removed.

Cost Impact: The code change proposal will not increase or decrease the cost of construction
This proposal imposes no additional compliance requirements and, therefore, neither increases nor decreases the cost of construction.
RE156-19
IECC: R405.4 (IRC N1105.4) (New)

Proponent: Joseph Cain, representing Solar Energy Industries Association (SEIA) (JoeCainPE@gmail.com)

2018 International Energy Conservation Code
Add new text as follows:

R405.4 (IRC N1105.4) On-site renewable energy. On-site renewable energy shall be considered as a reduction in energy use of the building.

Reason: The IECC should integrate energy efficiency measures and renewable energy systems. Builders should get credit for what they do. As presented by the Building Technologies Office of the Department of Energy's 2018 National Energy Codes Conference, according to the U.S. Energy Information Administration's AEO 2018 report, typical Residential End Uses include Space heating at 24% and Space cooling at 11%, for a combined space heating/cooling at 35% of all Residential Energy End Uses. Water heating accounts for 13.5% of Residential Energy End Uses. These figures illustrate that we have done a very good job of reducing regulated loads, such that unregulated loads now represent greater than 50% of all Residential Energy End Uses. Renewable energy systems can offset not only the unregulated loads, but can also offset the reduced regulated loads.

Compliance measures and compliance paths that focus only on building envelope measures and discourage or penalize renewable energy systems -- or fail to make renewable energy systems attractive to builders as a compliance option -- are focused on solving 35% of the problem. The IECC should encourage the use of energy efficiency plus renewable energy, to solve 100% of the problem.

Cost Impact: The code change proposal will not increase or decrease the cost of construction. Installation of an on-site photovoltaic system could increase or decrease the overall first cost of construction.

Proposal # 5687
2018 International Energy Conservation Code

Revise as follows:

**R405.4.2 (IRC N1105.4.2) Compliance report.** Compliance software tools shall generate a report that documents that the *proposed design* complies with Section R405.3. A compliance report on the *proposed design* shall be submitted with the application for the building permit. Upon completion of the building, a compliance report based on the as-built condition of the building shall be submitted to the *code official* before a certificate of occupancy is issued. Batch sampling of buildings to determine energy code compliance shall only be allowed for stacked multiple-family units. Compliance reports shall include information in accordance with Sections R405.4.2.1 and R405.4.2.2. Where the *proposed design* of a building could be built on different sites where the cardinal orientation of the building on each site is different, compliance of the *proposed design* for the purposes of the application for the building permit shall be based on the worst-case orientation, worst-case configuration, worst-case *building air leakage* and worst-case duct leakage. Such worst-case parameters shall be used as inputs to the compliance software for energy analysis.

**Reason:** The purpose of this code change proposal is to remove confusing and incomplete language from the performance path regarding “batch sampling” of buildings. Section R405.4.2 contains orphan language that implies that batch sampling might be acceptable for stacked multiple family units, but there is no process or criteria for “batch sampling” defined anywhere in the IECC. Before any sort of sampling is allowed, a number of very important questions must be addressed, such as which parts of the building may be batch sampled, what sample size must be collected, what happens in the event of a failure, etc. Although some common voluntary programs permit sampling for certain specified measures, the IECC does not currently allow this practice and should not until these important questions are addressed. Moreover, we are concerned that batch sampling would fail to ensure that every home meets the code, since presumably only some homes would be included in the sampling.

**Cost Impact:** The code change proposal will not increase or decrease the cost of construction

This proposal cleans up excess language that refers to sampling practices that do not currently exist in the IECC.

---

**Proposed Change:**

Revise as follows:

**R405.4.2 (IRC N1105.4.2) Compliance report.** Compliance software tools shall generate a report that documents that the *proposed design* complies with Section R405.3. A compliance report on the *proposed design* shall be submitted with the application for the building permit. Upon completion of the building, a compliance report based on the as-built condition of the building shall be submitted to the *code official* before a certificate of occupancy is issued. Batch sampling of buildings to determine energy code compliance shall only be allowed for stacked multiple-family units. Compliance reports shall include information in accordance with Sections R405.4.2.1 and R405.4.2.2. Where the *proposed design* of a building could be built on different sites where the cardinal orientation of the building on each site is different, compliance of the *proposed design* for the purposes of the application for the building permit shall be based on the worst-case orientation, worst-case configuration, worst-case *building air leakage* and worst-case duct leakage. Such worst-case parameters shall be used as inputs to the compliance software for energy analysis.

**Reason:** The purpose of this code change proposal is to remove confusing and incomplete language from the performance path regarding “batch sampling” of buildings. Section R405.4.2 contains orphan language that implies that batch sampling might be acceptable for stacked multiple family units, but there is no process or criteria for “batch sampling” defined anywhere in the IECC. Before any sort of sampling is allowed, a number of very important questions must be addressed, such as which parts of the building may be batch sampled, what sample size must be collected, what happens in the event of a failure, etc. Although some common voluntary programs permit sampling for certain specified measures, the IECC does not currently allow this practice and should not until these important questions are addressed. Moreover, we are concerned that batch sampling would fail to ensure that every home meets the code, since presumably only some homes would be included in the sampling.

**Cost Impact:** The code change proposal will not increase or decrease the cost of construction

This proposal cleans up excess language that refers to sampling practices that do not currently exist in the IECC.
R405.2 (IRC N1105.4.2) Compliance report. Compliance software tools shall generate a report that documents that the proposed design complies with Section R405.3. A compliance report on the proposed design shall be submitted with the application for the building permit. Upon completion of the building, a confirmed compliance report based on the as-built condition of the building shall be submitted to the code official before a certificate of occupancy is issued. Batch sampling of buildings to determine energy code compliance shall only be allowed for stacked multiple-family units. Compliance reports shall include information in accordance with Sections R405.4.2.1 and R405.4.2.2.

Where the proposed design of a building could be built on different sites where the cardinal orientation of the building on each site is different, compliance of the proposed design for the purposes of the application for the building permit shall be based on the worst-case orientation, worst-case configuration, worst-case building air leakage and worst-case duct leakage. Such worst-case parameters shall be used as inputs to the compliance software for energy analysis.

R405.4.2.1 (IRC N1105.4.2.1) Compliance report for permit application. A compliance report submitted with the application for building permit shall include the following:

1. Building street address, or other building site identification.
2. A statement indicating that the proposed design complies with Section R405.3. The name of the individual performing the analysis and generating the compliance report.
3. An inspection checklist documenting the building component characteristics of the proposed design as indicated in Table R405.5.2(1). The inspection checklist shall show results for both the standard reference design and the proposed design with user inputs to the compliance software to generate the results. The name and version of the compliance software tool.
4. A site-specific energy analysis report that is in compliance with Section R405.3. If requested by the authority having jurisdiction, documentation of all inputs entered into the software used to produce the results for the reference design and/or the rated home.
5. The name of the individual performing the analysis and generating the report. A certificate indicating that the proposed design complies with Section R405.3. The certificate shall document the building components energy specifications that are included in the calculation including, component level insulation R-values or U-factors, assumed duct system and building envelope air leakage testing assumptions, as well as, the type and rated efficiencies of proposed heating, cooling, mechanical ventilation, and service water heating equipment to be installed. If onsite renewable energy systems will be installed the certificate shall report the type and production size of the proposed system.
6. The name and version of the compliance software tool. When a site-specific report is not generated, the proposed design shall be based on the worst-case orientation and configuration of the rated home.

R405.4.2.2 (IRC N1105.4.2.2) Compliance confirmed compliance report for certificate of occupancy. A confirmed compliance report submitted for obtaining the certificate of occupancy shall be made site and address specific and include the following:

1. Building street address, or other building site identification.
2. A statement indicating that the as-built building complies with Section R405.3. The name of the individual performing the analysis and generating the report.
3. A certificate indicating that the building passes the performance matrix for code compliance and indicating the energy saving features of the building. The name and version of the compliance software tool.
4. A site-specific energy analysis report that is in compliance with Section R405.3. If requested by the authority having jurisdiction, documentation of all inputs entered into the software used to produce the results for the reference design and/or the rated home.
5. The name of the individual performing the analysis and generating the report. A final confirmed certificate indicating compliance based on inspection and statement indicating that the confirmed rated design of the built home complies with Section R405.3. The certificate shall report the energy features that were confirmed to be in the home including component level insulation R-values or U-factors, results from any required duct system and building envelope air leakage testing, as well as the type and rated efficiencies of the heating, cooling, mechanical ventilation, and service water heating equipment installed.
6. The name and version of the compliance software tool. When onsite renewable energy systems have been installed, the certificate shall report the type and production size of the installed system.

R405.4.3 (IRC N1105.4.3) Additional documentation. The code official shall be permitted to require the following documents:

1. Documentation of the building component characteristics of the standard reference design.
2. A certification signed by the builder providing the building component characteristics of the proposed design as given in Table R405.5.2(1).
3. Documentation of the actual values used in the software calculations for the proposed design.
Reason: EnergyLogic began to use the Section R405 Simulated Performance alternative and the cost compliance report with our Builder clients to demonstrate energy code compliance when the 2009 IECC was adopted by jurisdictions in the Denver Metro area. We fundamentally defined the process by which the path was used at the time as most jurisdictions did not have experience using it. Use of the pathway took off as we demonstrated that the systems thinking, building science trade-off approach offered tremendous flexibility for how to build a cost-effective code compliant house within a defined structure that ensured both jurisdictional and third-party stringent verification. Therefore, in the 2015 code development cycle we decided to define the process by which the Simulated Performance path was successfully being implemented in Colorado in the body of the IECC to help jurisdictions and builders better understand how to implement the pathway to gain flexibility of choice and trade-off, as well as, to ensure verification that backs it up for compliance.

In the 2021 code adoption cycle, we propose to update the compliance requirements based on what we have learned over the years using the path to help thousands of homes a year demonstrate compliance with the IECC. The changes we propose offer clarification and simplification rather than actually changing what is required. For example, the use of the terms proposed and confirmed to refer to documents that must be part of the document set needed to obtain the building permit and certificate of occupancy is more clearly laid out. In addition, section R405.4.2.1 Compliance report for permit application and section R405.4.2.2 Confirmed compliance report for certificate of occupancy, have been consolidated and reordered to more clearly identify for the jurisdiction having authority the documentation needed to be reviewed to demonstrate compliance.

Cost Impact: The code change proposal will not increase or decrease the cost of construction. There is no cost implication with these changes to the code. The proposal does not add new requirements but rather cleans up the section for better understanding and use by the jurisdictions and builders that choose it.
Proponent: Kirk Nagle, City of Aurora, representing Myself (knagle@auroragov.org)

2018 International Energy Conservation Code

Revise as follows:

R405.4.2.1 (IRC N1105.4.2.1) Compliance report for permit application. A compliance report submitted with the application for building permit shall include the following:

1. Building street address, or other building site identification.
2. Declare simulated performance path
3. A statement indicating that the proposed design complies with Section R405.3.
4. An inspection checklist documenting the building component characteristics of the proposed design as indicated in Table R405.5.2(1). The inspection checklist shall show results for both the standard reference design and the proposed design with user inputs to the compliance software to generate the results.
5. A site-specific energy analysis report that is in compliance with Section R405.3.
6. The name of the individual performing the analysis and generating the report.
7. The name and version of the compliance software tool.

Reason: This code change is being proposed to clarify the energy path to the code official and the documentation for permit. Many reports do not specify the path that is being proposed and the code official has to contact the applicant to verify the energy path they are intending to use, to comply with the energy code. By providing the method of compliance the code official can focus on the details of the report and this information will expedite the permit process time.

Cost Impact: The code change proposal will increase the cost of construction
This will increase the cost of construction by a very minor ammount, adding a data entry to report.
2018 International Energy Conservation Code

Revise as follows:

R402.1.5 (IRC N1102.1.5) Total UA alternative. Where the total building thermal envelope UA, the sum of U-factor times assembly area, is less than or equal to the total UA resulting from multiplying the U-factors in Table R402.1.4 by the same assembly area as in the proposed building, the building shall be considered to be in compliance with Table R402.1.2. The UA calculation shall be performed using a method consistent with the ASHRAE Handbook of Fundamentals and shall include the thermal bridging effects of framing materials. In addition to UA compliance, the SHGC requirements shall be met.

R402.5 (IRC N1102.5) R402.1.5.1 (IRC N1102.5.1) Maximum fenestration U-factor and SHGC (Mandatory). The area-weighted average maximum fenestration U-factor permitted using tradeoffs from Section R402.1.5 or R405 shall be 0.48 in Climate Zones 4 and 5 and 0.40 in Climate Zones 6 through 8 for vertical fenestration, and 0.75 in Climate Zones 4 through 8 for skylights. The area-weighted average maximum fenestration SHGC permitted using Section R405 in Climate Zones 1 through 3 shall be 0.50.

Add new text as follows:

R405.5.2.1 (IRC N1105.5.2.1) Maximum fenestration U-factor and SHGC (Mandatory) The area-weighted average maximum fenestration U-factor permitted using Section R405 shall be 0.48 in Climate Zones 4 and 5 and 0.40 in Climate Zones 6 through 8 for vertical fenestration, and 0.75 in Climate Zones 4 through 8 for skylights. The area-weighted average maximum fenestration SHGC permitted using Section R405 in Climate Zones 1 through 3 shall be 0.50.

Reason: This proposal relocates and apportions the provisions of Section R402.5 to their appropriate locations as they apply specifically to the methodologies therein. No change in stringency or applicability is proposed.

Cost Impact: The code change proposal will not increase or decrease the cost of construction. There is no cost implication aligned with this proposal. Rather, it is an exercise steeped in clarification such that a provision "hanging" at the end of Section R402, is appropriately assigned to the "Total UA Alternative" and the "Simulated Performance Alternative," accordingly. No change to stringency is proposed.
### TABLE R405.5.2(1) [IRC N1105.5.2(1)]
SPECIFICATIONS FOR THE STANDARD REFERENCE AND PROPOSED DESIGNS

Portions of table not shown remain unchanged.

<table>
<thead>
<tr>
<th>BUILDING COMPONENT</th>
<th>STANDARD REFERENCE DESIGN</th>
<th>PROPOSED DESIGN</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vertical fenestration other than opaque doors</td>
<td></td>
<td>As proposed</td>
</tr>
<tr>
<td>Vertical Fenestration Total area = (a) The proposed vertical fenestration glazing area (AVF), where the proposed total fenestration glazing area (AF) is less than 15 percent of the conditioned floor area (CFA)</td>
<td></td>
<td>As proposed</td>
</tr>
<tr>
<td>(b) The adjusted vertical fenestration area (AFcAF) where the AF is 15 percent or more of the CFA</td>
<td></td>
<td>As proposed</td>
</tr>
<tr>
<td>Orientation: equally distributed to four cardinal compass orientations (N, E, S &amp; W).</td>
<td></td>
<td>As proposed</td>
</tr>
<tr>
<td>U-factor: as specified for Fenestration in Table R402.1.4.</td>
<td></td>
<td>As proposed</td>
</tr>
<tr>
<td>SHGC: as specified for Glares Fenestration in Table R402.1.2 except for climate zones without an SHGC requirement, the SHGC shall be equal to 0.40</td>
<td></td>
<td>As proposed</td>
</tr>
<tr>
<td>Interior shade fraction: 0.92(0.21 x SHGC for the standard reference design).</td>
<td></td>
<td>Interior shade fraction: 0.92(0.21 x SHGC as proposed)</td>
</tr>
<tr>
<td>External shading: none</td>
<td></td>
<td>As proposed</td>
</tr>
</tbody>
</table>

- Skylights

<table>
<thead>
<tr>
<th>Building Component</th>
<th>Standard Reference Design</th>
<th>Proposed Design</th>
</tr>
</thead>
<tbody>
<tr>
<td>Skylights</td>
<td></td>
<td>As proposed</td>
</tr>
<tr>
<td>(a) The proposed skylight area (AFcAF) where the proposed total fenestration area (AF) is less than 15 percent of the conditioned floor area (CFA)</td>
<td></td>
<td>As proposed</td>
</tr>
<tr>
<td>(b) The adjusted skylight area (AFcAF) where the AF is 15 percent or more of the CFA</td>
<td></td>
<td>As proposed</td>
</tr>
<tr>
<td>Orientation: as proposed</td>
<td></td>
<td>As proposed</td>
</tr>
<tr>
<td>U-factor: as specified for Skylights in Table R602.1.2</td>
<td></td>
<td>As proposed</td>
</tr>
<tr>
<td>SHGC: as specified for Glazed Fenestration and footnotes (a) in Table R402.1.2 except for climate zones without an SHGC requirement, the SHGC shall be equal to 0.40</td>
<td></td>
<td>As proposed</td>
</tr>
<tr>
<td>For the area of proposed skylights equipped and rated with factory-installed interior shades, the interior shade fraction is 0.92(0.21 x SHGC) (RSHGC as above for the standard reference design)</td>
<td>As proposed, with shades assumed closed 50% of the daylight hours</td>
<td></td>
</tr>
<tr>
<td>External shading: none</td>
<td></td>
<td>As proposed</td>
</tr>
</tbody>
</table>
For SI: 1 square foot = 0.093 m², 1 British thermal unit = 1055 J, 1 pound per square foot = 4.88 kg/m², 1 gallon (US) = 3.785 L, 
°C = (°F-32)/1.8, 1 degree = 0.79 rad.

a. Where required by the code official, testing shall be conducted by an approved party. Hourly calculations as specified in the ASHRAE Handbook of Fundamentals, or the equivalent, shall be used to determine the energy loads resulting from infiltration.


c. Thermal storage element shall mean a component that is not part of the floors, walls or ceilings that is part of a passive solar system, and that provides thermal storage such as enclosed water columns, rock beds, or phase-change containers. A thermal storage element shall be in the same room as fenestration that faces within 15 degrees (0.26 rad) of true south, or shall be connected to such a room with pipes or ducts that allow the element to be actively charged.

d. For a proposed design with multiple heating, cooling or water heating systems using different fuel types, the applicable standard reference design system capacities and fuel types shall be weighted in accordance with their respective loads as calculated by accepted engineering practice for each equipment and fuel type present.

e. For a proposed design without a proposed heating system, a heating system having the prevailing federal minimum efficiency shall be assumed for both the standard reference design and proposed design.

f. For a proposed design home without a proposed cooling system, an electric air conditioner having the prevailing federal minimum efficiency shall be assumed for both the standard reference design and proposed design.

g. For a proposed design with a nonstorage-type water heater, a 40-gallon storage-type water heater having the prevailing federal minimum energy factor for the same fuel as the predominant heating fuel type shall be assumed. For a proposed design without a proposed water heater, a 40-gallon storage-type water heater having the prevailing federal minimum efficiency for the same fuel as the predominant heating fuel type shall be assumed for both the proposed design and standard reference design.

h. Light-transmitting fenestration area includes the area of sash, curbing or other framing elements that are part of the conditioned space enclosure, including light-transmitting assemblies in the walls bounding conditioned basements. For doors where the light-transmitting opening is less than 50 percent of the door area, only the light-transmitting area is included. For residences with conditioned basements, R-2 and R-4 residences, and for townhouses, the following formula shall be used to determine glazing fenestration area:

\[ AF = A_s \times FA \times F \]

where:

- \( AF \) = Total glazing Proposed total fenestration area.
- \( A_s \) = Standard reference design total glazing fenestration area.
- \( FA \) = \((Above-grade thermal boundary gross wall area)/(above-grade boundary wall area + 0.5 \times below-grade boundary wall area)\).
- \( F \) = \((above-grade thermal boundary wall area)/(above-grade thermal boundary wall area + common wall area)\) or 0.56, whichever is greater.
Reason: The IECC residential simulated energy performance analysis standard reference design specification table has historically included skylight area in the “Glazing” row, as reflected in the 2012 IECC:

and where: Thermal boundary wall is any wall that separates conditioned space from unconditioned space or ambient conditions. Above-grade thermal boundary wall is any thermal boundary wall component not in contact with soil. Below-grade boundary wall is any thermal boundary wall in soil contact. 

Common wall area is the area of walls shared with an adjoining dwelling unit.

L_{AF,A}, and CFA are in the same units.
Footnote (a) clearly refers to “the area of ... curbing ...” in the definition of “Glazing”, which is only germane to skylights on a roof. The commentary versions of the 2012 and prior editions reinforce this intent to cover skylight area in the glazing row for the reference design.

The approval of RE173-13 upset the applecart for skylights in the 2015 IECC. The proponent later acknowledged at 2018 IECC code hearings that it was not intentional, but the two major elements of that change took away the only place for skylights to be included in the reference design:

- “Glazing” was changed to “Vertical fenestration other than opaque doors”
- Footnote (a) was inexplicably deleted, rather than redefine fenestration area calculation rules.

Our proposed changes to Table R405.5.2(1) reinstate the allowance to include skylight area in the Standard Reference Design as part of the Total Fenestration Area when they are part of the proposed design, by adding the following:

1. Provisions for skylight area, U-factor and shading that mirror the Vertical Fenestration provisions, wherever practical.
2. Provisions for skylight SHGC that mirror those for Vertical Fenestration, with the addition of a reference to Footnote (b) of Table R402.1.2 specific to skylight SHGC.
3. Provisions for skylight orientation based upon “As Proposed”. Typically, skylight installation in residential construction is not able to be equally distributed to all four cardinal compass orientations, as assumed for vertical fenestration under the Simulated Performance Alternative provisions.
4. Suitable interior shading provisions that are used when any of the proposed skylights are rated products that include integral interior shading.

This proposal also includes the following coordinating changes:

1. In footnote (h), reference to “glazing area” is replaced by “fenestration area”, while restoring needed clarifying language from old footnote (a) defining what is included in calculating the area of various fenestration products regardless of slope or position on the envelope.
2. Provisions are added to reduce the vertical fenestration area and skylight area proportionally for the Standard Reference Design, whenever any skylight area is proposed and total fenestration area equals or exceeds 15% of conditioned floor area.
**Bibliography:** 2012 IECC, Table R405.5.2(1)

**Cost Impact:** The code change proposal will not increase or decrease the cost of construction
The code change proposal will not increase the cost of construction but rather reinstates language that was unintentionally removed.
2018 International Energy Conservation Code

Revise as follows:

### TABLE R405.5.2(1) [IRC N1105.5.2(1)]

**SPECIFICATIONS FOR THE STANDARD REFERENCE AND PROPOSED DESIGNS**

Portions of table not shown remain unchanged.

<table>
<thead>
<tr>
<th>BUILDING COMPONENT</th>
<th>STANDARD REFERENCE DESIGN</th>
<th>PROPOSED DESIGN</th>
</tr>
</thead>
<tbody>
<tr>
<td>Service water heating&lt;sup&gt;a, i, p&lt;/sup&gt;</td>
<td>As proposed.</td>
<td>As proposed.</td>
</tr>
<tr>
<td><strong>Use:</strong></td>
<td>Same as proposed design.</td>
<td>Use, in units of gal/day = (30 + (10 × N&lt;sub&gt;b&lt;/sub&gt;)) × (1-HWDS)</td>
</tr>
<tr>
<td><strong>Use, in units of gal/day = 30 + (10 × N&lt;sub&gt;b&lt;/sub&gt;)</strong></td>
<td>N&lt;sub&gt;b&lt;/sub&gt; = number of bedrooms.</td>
<td>where:</td>
</tr>
<tr>
<td><strong>where:</strong></td>
<td></td>
<td>HWDS = factor for the compactness of the hot water distribution system</td>
</tr>
<tr>
<td><strong>Compactness Ratio</strong></td>
<td>HWDS Factor</td>
<td></td>
</tr>
<tr>
<td>1 story</td>
<td>2 or More Stories</td>
<td></td>
</tr>
<tr>
<td>&gt;60%</td>
<td>&gt;30%</td>
<td></td>
</tr>
<tr>
<td>&gt;30% to ≤ 60%</td>
<td>&gt;15% to ≤ 30%</td>
<td></td>
</tr>
<tr>
<td>&gt;15% to ≤ 30%</td>
<td>&gt;7.5% to ≤ 15%</td>
<td></td>
</tr>
<tr>
<td>≤ 15%</td>
<td>≤ 7.5%</td>
<td></td>
</tr>
<tr>
<td></td>
<td>0.15</td>
<td></td>
</tr>
</tbody>
</table>

For SI: 1 square foot = 0.93 m<sup>2</sup>, 1 British thermal unit = 1055 J, 1 pound per square foot = 4.88 kg/m<sup>2</sup>, 1 gallon (US) = 3.785 L,

<sup>a</sup> C = (°F-32)/1.8, 1 degree = 0.79 rad.

---

- **a.** Where required by the code official, testing shall be conducted by an approved party. Hourly calculations as specified in the ASHRAE Handbook of Fundamentals, or the equivalent, shall be used to determine the energy loads resulting from infiltration.
- **c.** Thermal storage element shall mean a component that is not part of the floors, walls or ceilings that is part of a passive solar system, and that provides thermal storage such as enclosed water columns, rock beds, or phase-change containers. A thermal storage element shall be in the same room as fenestration that faces within 15 degrees (0.26 rad) of true south, or shall be connected to such a room with pipes or ducts that allow the element to be actively charged.
- **d.** For a proposed design with multiple heating, cooling or water heating systems using different fuel types, the applicable standard reference design system capacities and fuel types shall be weighted in accordance with their respective loads as calculated by accepted engineering practice for each equipment and fuel type present.
- **e.** For a proposed design without a proposed heating system, a heating system having the prevailing federal minimum efficiency shall be assumed for both the standard reference design and proposed design.
- **f.** For a proposed design without a proposed cooling system, an electric air conditioner having the prevailing federal minimum efficiency shall be assumed for both the standard reference design and the proposed design.
- **g.** For a proposed design with a nonstorage-type water heater, a 40-gallon storage-type water heater having the prevailing federal minimum energy factor for the same fuel as the predominant heating fuel type shall be assumed. For a proposed design without a proposed water heater, a 40-gallon storage-type water heater having the prevailing federal minimum efficiency for the same fuel as the predominant heating fuel type shall be assumed for both the proposed design and standard reference design.
- **h.** For residences with conditioned basements, R-2 and R-4 residences, and for townhouses, the following formula shall be used to determine glazing area:

\[
AF = A_g \times FA \times F
\]

where:
$AF = \text{Total glazing area.}$

$A_s = \text{Standard reference design total glazing area.}$

$FA = \frac{\text{Above-grade thermal boundary gross wall area}}{\text{Above-grade boundary wall area} + 0.5 \times \text{Below-grade boundary wall area}}.$

$F = \frac{\text{Above-grade thermal boundary wall area}}{\text{Above-grade thermal boundary wall area} + \text{Common wall area}} \text{ or } 0.56, \text{ whichever is greater.}$

and where:

Thermal boundary wall is any wall that separates conditioned space from unconditioned space or ambient conditions.

Above-grade thermal boundary wall is any thermal boundary wall component not in contact with soil.

Below-grade boundary wall is any thermal boundary wall in soil contact.

Common wall area is the area of walls shared with an adjoining dwelling unit.

$L$ and $CFA$ are in the same units.

i. The factor for the compactness of the hot water distribution system is the ratio of the area of the rectangle that bounds the source of hot water and the fixtures that it serves (the “hot water rectangle”) divided by the floor area of the dwelling.

1. Sources of hot water include water heaters, or in multi-family buildings with central water heating systems, circulation loops or electric heat traced pipes.

2. The hot water rectangle shall include the source of hot water and the points of termination of all hot water fixture supply piping.

3. The hot water rectangle shall be shown on the floor plans and the area shall be computed to the nearest square foot.

4. Where there is more than one water heater and each water heater serves different plumbing fixtures and appliances, it is permissible to establish a separate hot water rectangle for each hot water distribution system and add the area of these rectangles together to determine the Compactness Ratio.

5. The basement or attic shall be counted as a story when it contains the water heater.

6. Compliance shall be demonstrated by providing a drawing on the plans that shows the hot water distribution system rectangle(s), comparing the area of the rectangle(s) to the area of the dwelling and identifying the appropriate compactness ratio and HWDS factor.

Reason: The purpose of this proposal is to encourage the architectural compactness of the location of the wet rooms and the water heaters that serve them.

Wet rooms contain plumbing fixtures and appliances. They are often located far apart from each other and from the water heater that serves them. The long distances between them results in long and often larger diameter piping runs. These piping runs need to be cleared of the ambient temperature water in them before hot water can arrive. This addition time is often annoying to consumers and the waste of water and energy while waiting can be costly.

If the architect locates the wet rooms closer together and to the water heater that serves them, it makes it possible for the pipe runs to be shorter and often of a smaller diameter. The reduced volume of ambient temperature water clears out more quickly, increasing customer satisfaction. In addition, the associated water and energy waste is less, reducing operating costs.

Benefits:

1. This proposal provides a credit when the wet rooms are located close to each other. There is no penalty for not taking advantage of the credit.

2. The builder still has flexibility over where to put the wet rooms and the water heater(s). It is possible to take advantage of the credit in larger dwellings by having a water heater associated with each group of wet rooms.

3. The credit can be applied to single and multi-family dwellings. Where the dwelling has its own water heater, the calculation is done with the water heater as the source of hot water. In multi-family buildings with central water heating systems, the calculation is done from where the branch off the circulation loop or heat traced trunk line to the apartment begins.

4. Compliance can be demonstrated on the drawings and verified during plan check.

How to Implement the Proposed Credit for Architectural Compactness
Locate the water heater and the hot water fixtures and appliances.

2. Draw a rectangle through the center line of the water heater and the plumbing walls next to the hot water fixtures and appliances.

3. Calculate the area of this rectangle.

4. Divide this area by the conditioned floor area of the home to get the Compactness Ratio.

5. Determine if a credit can be taken and how large it can be.

---

Habitat for Humanity, Stockton CA

Plumbing wall goes around the middle bathroom

Bounded area is roughly 50 sq ft

Plumbing wall is roughly 22 feet long
1-Story, 3 Bedroom, 2 Bath
1. Same builder, similar size dwelling.
2. Different floor plan with wet rooms located close to each other.
3. Move the water heater very close to the wet rooms.
4. Conditioned floor space: 1,223 SF
5. Hot water system rectangle: 8 x 9 = 72 SF
6. Compactness Ratio: 72 / 1,223 = 5.9%
7. HWDS Factor for 1-Story: 0.15

2 story, 4 bedrooms, 3 bath 2625 sq ft Meritage Homes Bakersfield

Camden, Chula Vista - Camden Sierra at Otay Ranch, 1A

Cost Impact: The code change proposal will not increase or decrease the cost of construction.

Locating the wet rooms closer together and to the water heater that serves them reduces the cost of installing the hot water distribution system. Typical dwellings have very large compactness ratios, often much larger than the 60% cut off point for obtaining this credit. Reducing the ratio from 75% to 20% in a 1-story single family detached dwelling can reduce the first costs by $1,000-2,000.

The reason we are not claiming a cost reduction is that there will be some cost for the architect to (re)design a given nominal floor plan to take advantage of the credit. For production builders this cost can be amortized over many homes, so at some point, it will cost less to build all future houses with this floor plan.

Another reason we are not claiming it will reduce construction costs is that if the builder chooses to take advantage of the credit by installing more than one water heater so that each water heater is close to the wet rooms it serves, there will be a cost for the second water heater. Some, perhaps all of the extra cost due to the additional water heater(s) will be offset by the reduced costs of the hot water distribution system. However, multiple water heaters are often installed in larger dwellings and where this is already the case, the marginal cost of locating closer to groups of wet rooms is likely to be small compared to the savings in the hot water distribution system. And in dwellings where a circulation loop was planned in order to get hot water to fixtures quickly, installing a second water heater close each group of wet rooms can eliminate the need for and costs of the circulation loop.
RE163-19

IECC: TABLE R405.5.2(1) [IRC N1105.5.2(1)]

Proponent: Ed Osann, Natural Resources Defense Council, representing Natural Resources Defense Council (eosann@nrdc.org)

2018 International Energy Conservation Code

Revise as follows:

TABLE R405.5.2(1) [IRC N1105.5.2(1)]

SPECIFICATIONS FOR THE STANDARD REFERENCE AND PROPOSED DESIGNS

Portions of table not shown remain unchanged.

<table>
<thead>
<tr>
<th>BUILDING COMPONENT</th>
<th>STANDARD REFERENCE DESIGN</th>
<th>PROPOSED DESIGN</th>
</tr>
</thead>
<tbody>
<tr>
<td>Service water heating</td>
<td>As proposed. Use: same as proposed design.</td>
<td>As proposed Use, in units of gal/day = 30.5 + (8.5 \times N_b)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>where: N_b = number of bedrooms.</td>
</tr>
</tbody>
</table>

For SI: 1 square foot = 0.93 m², 1 British thermal unit = 1055 J, 1 pound per square foot = 4.88 kg/m², 1 gallon (US) = 3.785 L,

°C = (°F - 32)/1.8, 1 degree = 0.79 rad.

d. For a proposed design with multiple heating, cooling or water heating systems using different fuel types, the applicable standard reference design system capacities and fuel types shall be weighted in accordance with their respective loads as calculated by accepted engineering practice for each equipment and fuel type present.

e. For a proposed design without a proposed heating system, a heating system having the prevailing federal minimum efficiency shall be assumed for both the standard reference design and proposed design.

f. For a proposed design home without a proposed cooling system, an electric air conditioner having the prevailing federal minimum efficiency shall be assumed for both the standard reference design and the proposed design.

g. For a proposed design with a nonstorage-type water heater, a 40-gallon storage-type water heater having the prevailing federal minimum energy factor for the same fuel as the predominant heating fuel type shall be assumed. For a proposed design without a proposed water heater, a 40-gallon storage-type water heater having the prevailing federal minimum efficiency for the same fuel as the predominant heating fuel type shall be assumed for both the proposed design and standard reference design.

Reason: This proposal will revise the formula in Table R405.5.2(1) that specifies the volume of domestic hot water usage in the residential performance path. This formula has remained unchanged in the code since the very first edition of the IECC in 1998, even as residential hot water usage declined over this period. The proposal will reduce the stipulated daily volume of service hot water use by 15%. For example, under the current formula, the daily hot water use of a 3-bedroom home is 60 gallons, while under the proposal a 3-bedroom home would be assumed to draw 51 gallons of hot water. The formula currently applies to both the standard reference design and the builder's proposed design, and the proposal does not change this parity. Nor does the proposal change any other aspect of DHW system design or water heater selection. By overestimating hot water usage, the current formula overstates the relative share of hot water energy use compared with all other energy uses included in the performance path analysis. Revising this formula will make the characterization of hot water energy use more realistic, and acknowledge the progress made in improving the efficiency of hot water use over the last 20 years.

Background

The current formula for domestic hot water use has remained unchanged since the first edition of the IECC in 1998. It appears to have had its origin in the last CABO energy code development process of 1995-96, which produced a draft text that became the ICC’s template for the first edition of the IECC. (ICC Staff) In the 20+ years since the adoption of this formula, the drivers of domestic hot water usage have changed, in large part due to federal efficiency standards that save energy by reducing hot water use.

The US Department of Energy recognized that previous assumptions about residential hot water use were too high during the development of the current water heater efficiency standard adopted in 2010. (DOE STD) In the course of developing this standard, DOE reviewed the hot water model developed during the previous rulemaking that concluded in 2001 and was based on 1990s-era appliance performance. For its new analysis, DOE developed a new set of draw patterns based on field data assembled in a Lawrence Berkeley National Laboratory report. (Lutz et al) The LBNL report incorporated data collected by 10 independent studies involving 142 houses averaging 3.04 occupants, and 1.5 million hot water draws. The LBNL report found an average daily median volume of hot water use among its sample of 50.6 gallons.

In its 2009 Technical Support Document (DOE TSD) for the 2010 water heater standard, DOE noted that --
The Hot Water Draw Model incorporates the parameters for clothes washer and dishwasher hot water use. These parameters reflect assumptions about clothes washer and dishwasher water use as they existed in the 1990s. Since that time, there has been a considerable change to clothes washer and dishwasher technology that has resulted in lower hot water use. In particular, updated Federal energy conservation standards for clothes washers that became effective in 2007 and for dishwashers that will become effective in 2010 have a significant impact on clothes washer and dishwasher hot water use.

The baseline water use for clothes washers in the 1990s was 39.2 gallons/cycle and the water use calculated based on the 2007 standard is 21.0 gallons/cycle. The baseline water use for dishwashers in the 1990s was 8.2 gallons/cycle and the water use calculated based on the 2010 standard is 6.5 gallons/cycle. Therefore, DOE updated the draw model to account for the reduced hot water use by adjusting the dishwasher and clothes washer water use variables to account for the new standards. The results are shown in Table 7-B.3.1. For example, the impact on gas-fired storage water heaters was a reduction of the average daily water use by 10.7 percent.

In the TSD's accompanying table, the results of these revisions to the draw model are shown for four types of water heater (gas-fired storage, electric, oil-fired, and gas instantaneous), with water use reductions for all of them clustering close to the average reduction of 10.1 percent for the group.

DOE took further note in the reduction in residential hot water use during the development of a revised test procedure for hot water heaters adopted in 2014. In its 2013 NOPR on the revised test procedure (DOE TP NOPR), DOE referred once again to the LBNL report, stating --

"LBNL found that typical usage in North America is characterized by . . . a smaller volume of water per day than is currently prescribed in the residential test method . . . ."

More recently, the Water Research Foundation's "Residential End Use of Water, Version 2" (REUWS 2) report published in 2016 documented substantial reductions in residential indoor water use compared with a similar assessment in 1999. Additionally, REUWS 2 specifically collected data on hot water use in a subset of its sampled homes (94 homes in 10 cities), and found an average use of 45.5 gallons per household per day. The median number of bedrooms in this sample was 3.0, which squares with the US national median bedroom count of 3.0 recorded by the US Census in 2015. (CENSUS)

Thus, LBNL's assessment published in 2010 found a median draw of 50.6 gallons per day and encouraged DOE to reduce the draw volumes in the hot water model for the 2010 efficiency standard as well as the draw volumes in the water heater test procedure revised in 2014. REUWS 2 corroborated the downward trend found by LBNL with a median daily draw of 45.5 gallons. In light of the foundational role of the LBNL report in the daily draw volumes used in both the current water heater standard and the water heater test procedure, this proposal achieves alignment between the data relied upon by DOE and the water usage stipulated for the performance path analysis in Table R405.5.2(1) by reducing the constants in the formula by 15%.

Effects of Proposal

The effect of the revision of the formula on the assumed daily hot water use in homes of varying numbers of bedrooms can be seen in the following table.

Service Hot Water Daily Usage for Reference Design and Proposed Design in Energy Performance Analysis

<table>
<thead>
<tr>
<th>Home Bedroom Count</th>
<th>Current Formula</th>
<th>Revised Formula</th>
</tr>
</thead>
<tbody>
<tr>
<td>2 Bedroom Home</td>
<td>50 gal/day</td>
<td>42.5 gal/day</td>
</tr>
<tr>
<td>3 Bedroom Home</td>
<td>60 gal/day</td>
<td>51.0 gal/day</td>
</tr>
<tr>
<td>4 Bedroom Home</td>
<td>70 gal/day</td>
<td>59.5 gal/day</td>
</tr>
<tr>
<td>5 Bedroom Home</td>
<td>80 gal/day</td>
<td>68.0 gal/day</td>
</tr>
</tbody>
</table>

It should be remembered that the daily hot water usage established by the formula in Table R405.5.2(1) does NOT serve as a performance requirement for appliances or fixtures in the home. Rather, it simply provides the deemed value of daily water use upon which the energy consumption of various equipment choices made by the builder can be quantified and brought into the calculation of the annual energy cost (or source energy consumption) of the whole building. The revision to the formula in this proposal would make the values used for hot water energy consumption in the performance analysis more reflective of recent residential water use patterns, and thus more realistic.


Cost Impact: The code change proposal will not increase or decrease the cost of construction. The proposal has no impact on the cost of construction. It revises the voluntary residential performance path by adjusting the volume of daily hot water usage assumed for both the reference design and the builder's proposed design. It contains no requirement that would raise the cost of water heating equipment.
IECC: TABLE R405.5.2(1) [IRC N1105.5.2(1)]

Proponent: Gary Klein, representing self (gsmklein@comcast.net)

2018 International Energy Conservation Code

Revise as follows:

TABLE R405.5.2(1) [IRC N1105.5.2(1)]

SPECIFICATIONS FOR THE STANDARD REFERENCE AND PROPOSED DESIGNS

Portions of table not shown remain unchanged.

<table>
<thead>
<tr>
<th>BUILDING COMPONENT</th>
<th>STANDARD REFERENCE DESIGN</th>
<th>PROPOSED DESIGN</th>
</tr>
</thead>
<tbody>
<tr>
<td>Service water heating</td>
<td>As proposed. Use: same as proposed design. Use, in units of gal/day = 30 + (10 × N&lt;sub&gt;d&lt;/sub&gt;)</td>
<td>As proposed</td>
</tr>
<tr>
<td></td>
<td></td>
<td>where:</td>
</tr>
<tr>
<td></td>
<td></td>
<td>N&lt;sub&gt;d&lt;/sub&gt; = number of bedrooms.</td>
</tr>
</tbody>
</table>

For SI: 1 square foot = 0.93 m², 1 British thermal unit = 1055 J, 1 pound per square foot = 4.88 kg/m², 1 gallon (US) = 3.785 L,
°C = (°F-32)/1.8, 1 degree = 0.79 rad.

g. For a proposed design with a nonstorage-type water heater, a 40-gallon storage-type water heater having an efficiency in accordance with the minimum federal efficiency standard using the same draw pattern from Appendix E, Subpart B of 10 CFR Part 430 (2019), for the same fuel as the predominant heating fuel type shall be assumed. For a proposed design without a proposed water heater, a 40-gallon storage-type water heater having an efficiency in accordance with the minimum federal efficiency standard using the same draw pattern from Appendix E, Subpart B of 10 CFR Part 430 (2019), for the same fuel as the predominant heating fuel type shall be assumed for both the proposed design and standard reference design.

Reason: Due to changes in 10 CFR § 430.32 (2018) the phrasing in this footnote needs to be revised. Due to the government shutdown it has not been possible to get comments from key staff on the proper way to revise this footnote.

Cost Impact: The code change proposal will not increase or decrease the cost of construction. The revision to the footnote will only change the requirements for comparing the proposed design to the standard reference design. It will not directly affect the actual cost of compliance.
IECC: TABLE R405.5.2(2) [IRC N1105.5.2(2)]

Proponent: Robby Schwarz, EnergyLogic, representing EnergyLogic (robby@nrglogic.com)

2018 International Energy Conservation Code

Revise as follows:

TABLE R405.5.2(2) [IRC N1105.5.2(2)]
DEFAULT DISTRIBUTION SYSTEM EFFICIENCIES FOR PROPOSED DESIGNS

Portions of table not shown remain unchanged.

<table>
<thead>
<tr>
<th>DISTRIBUTION SYSTEM CONFIGURATION AND CONDITION</th>
<th>FORCED AIR SYSTEMS</th>
<th>HYDRONIC SYSTEMS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Distribution system components located in unconditioned space</td>
<td>—</td>
<td>0.95</td>
</tr>
<tr>
<td>Untested distribution systems entirely located in conditioned space(^2)</td>
<td>0.88</td>
<td>1</td>
</tr>
<tr>
<td>Proposed “reduced leakage” when the installed air distribution system is located entirely within the continuous air barrier assembly and building thermal envelope’s defined conditioned space as verified through inspection before drywall has been installed(^6)</td>
<td>0.96</td>
<td>—</td>
</tr>
<tr>
<td>“Ductless”/“Ductless” systems(^d)</td>
<td>1</td>
<td>—</td>
</tr>
</tbody>
</table>

For SI: 1 cubic foot per minute = 0.47 L/s, 1 square foot = 0.093 m\(^2\), 1 pound per square inch = 6895 Pa, 1 inch water gauge = 1250 Pa.

a. Default values in this table are for untested distribution systems, which must still meet minimum requirements for duct system insulation.
b. Hydronic systems shall mean those systems that distribute heating and cooling energy directly to individual spaces using liquids pumped through closed-loop piping and that do not depend on ducted, forced airflow to maintain space temperatures.
c. Entire system in conditioned space shall mean that no component of the distribution system, including the air-handler unit, is located outside of the conditioned space.
d. Ductless systems shall be allowed to have forced airflow across a coil but shall not have any ducted airflow external to the manufacturer’s air-handler enclosure.
e. For homes with thermal distribution systems documented through visual verification at a rough stage of construction before drywall has been installed to be entirely within the continuous air barrier assembly and building thermal envelope of conditioned space, including all ducts and the manufacturer’s air handler enclosure, a DSE of 0.96 shall be applied to the Proposed Design without the requirement to conduct duct leakage testing. Alternatively, Total leakage of not greater than 4 cfm per 100 ft\(^2\) of conditioned floor area at a pressure difference of 0.1 inches w.g. (25 Pa) across the entire system, including the manufacturer’s air handler enclosure, shall be deemed to meet this requirement without measurement of leakage to outdoors.

Reason: The energy penalty or loss of duct leakage is different for duct systems that are located inside or outside of the buildings continuous air barrier assembly. The 2006 IECC recognized this in the IECC table titled, “DEFAULT DISTRIBUTION SYSTEM EFFICIENCIES FOR PROPOSED DESIGNS” that accompanies the proposed and reference home table for the Simulated Performance Alternative path. At some point this was removed, but since the energy code only requires testing for Total duct leakage it makes sense to add it back in. If the entirety of the duct system including the air handler cabinet is confirmed to be located inside conditioned space as defined by the continuous air barrier and thermal envelope assemblies, then the likelihood of the system leaking to the outdoors is little. Therefore, the energy loss of duct leakage to outside would also be little. If testing is not performed for duct leakage to outside a small penalty should be assessed which this proposal provided. If, alternatively, a total duct leakage test is performed then the total duct leakage test results can be used in the modeling for leakage to outside which this proposal also allows as long as the total duct leakage number is not greater than 4 CFM per 100 ft\(^2\) of conditioned floor area.

This proposal, although allowing verified HVAC duct systems not to be tested for duct leakage to outdoors, does assess a DSE of 0.96 which equates to a 4% energy loss for the system. Thus, if needed for compliance or to allow designed tradeoffs to be calculated in the software, duct leakage could be tested to demonstrate a reduced leakage level below this rate.

Cost Impact: The code change proposal will not increase or decrease the cost of construction.

In most cases this proposal would lower the cost of 3rd party compliance with the IECC as a single total duct leakage test could be used to document location and leakage of the duct system allowing for no testing to occur to quantify duct leakage to the outdoors.

Proposal # 5280

RE165-19
RE166-19

IECC: TABLE R405.5.2(1), [IRC N1105.5.2(1)]

Proponent: Gary Klein, representing self (gsmklein@comcast.net)

2018 International Energy Conservation Code

Revise as follows:

TABLE R405.5.2(1), [IRC N1105.5.2(1)]

SPECIFICATIONS FOR THE STANDARD REFERENCE AND PROPOSED DESIGNS

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<table>
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<tr>
<th>BUILDING COMPONENT</th>
<th>STANDARD REFERENCE DESIGN</th>
<th>PROPOSED DESIGN</th>
</tr>
</thead>
<tbody>
<tr>
<td>Service water heating</td>
<td>The efficiency shall be selected based on a water heater with the same first hour rating and draw pattern as the As proposed water heater.</td>
<td>As proposed</td>
</tr>
<tr>
<td></td>
<td>Use: same as proposed design.</td>
<td>Use, in units of gal/day = 30 + (10 × N_b)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>where:</td>
</tr>
<tr>
<td></td>
<td></td>
<td>N_b = number of bedrooms.</td>
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</table>

For SI: 1 square foot = 0.93 m², 1 British thermal unit = 1055 J, 1 pound per square foot = 4.88 kg/m², 1 gallon (US) = 3.785 L.

° C = (° F - 32)/1.8, 1 degree = 0.79 rad.

   a. Where required by the code official, testing shall be conducted by an approved party. Hourly calculations as specified in the ASHRAE Handbook of Fundamentals, or the equivalent, shall be used to determine the energy loads resulting from infiltration.
   c. Thermal storage element shall mean a component that is not part of the floors, walls or ceilings that is part of a passive solar system, and that provides thermal storage such as enclosed water columns, rock beds, or phase-change containers. A thermal storage element shall be in the same room as fenestration that faces within 15 degrees (0.26 rad) of true south, or shall be connected to such a room with pipes or ducts that allow the element to be actively charged.
   d. For a proposed design with multiple heating, cooling or water heating systems using different fuel types, the applicable standard reference design system capacities and fuel types shall be weighted in accordance with their respective loads as calculated by accepted engineering practice for each equipment and fuel type present.
   e. For a proposed design without a proposed heating system, a heating system having the prevailing federal minimum efficiency shall be assumed for both the standard reference design and proposed design.
   f. For a proposed design without a proposed cooling system, an electric air conditioner having the prevailing federal minimum efficiency shall be assumed for both the standard reference design and the proposed design.
   g. For a proposed design with a nonstorage-type water heater, a 40-gallon storage-type water heater having the prevailing federal minimum energy factor for the same fuel as the predominant heating fuel type shall be assumed. For a proposed design without a proposed water heater, a 40-gallon storage-type water heater having the prevailing federal minimum efficiency for the same fuel as the predominant heating fuel type shall be assumed for both the proposed design and standard reference design.
   h. For residences with conditioned basements, R-2 and R-4 residences, and for townhouses, the following formula shall be used to determine glazing area:

   \[
   AF = A_e \times FA \times F
   \]

   where:

   AF = Total glazing area.
   A_e = Standard reference design total glazing area.
   FA = (Above-grade thermal boundary gross wall area)/(above-grade boundary wall area + 0.5 × below-grade boundary wall area).
   F = (above-grade thermal boundary wall area)/(above-grade thermal boundary wall area + common wall area) or 0.56, whichever is greater.
and where:

Thermal boundary wall is any wall that separates conditioned space from unconditioned space or ambient conditions.

Above-grade thermal boundary wall is any thermal boundary wall component not in contact with soil.

Below-grade boundary wall is any thermal boundary wall in soil contact.

Common wall area is the area of walls shared with an adjoining dwelling unit.

$L$ and $CFA$ are in the same units.

**Reason:** The method of test for water heater efficiency was updated in 10 CFR §430.32 (2018). The proposed changes to the service water heating row in the performance table reflect these changes. The two deleted footnotes referred to in this row do not appear to be related to water heating.

**Cost Impact:** The code change proposal will not increase or decrease the cost of construction. The updates to the table are the same in both the standard reference and the proposed columns. No new requirements are imposed on construction practices, hence no changes to the cost of construction are expected.

Proposal # 5287

RE166-19
**2018 International Energy Conservation Code**

Revise as follows:

### TABLE R405.5.2(1) [IRC N1105.5.2(1)]

**SPECIFICATIONS FOR THE STANDARD REFERENCE AND PROPOSED DESIGNS**

Portions of table not shown remain unchanged.

<table>
<thead>
<tr>
<th>BUILDING COMPONENT</th>
<th>STANDARD REFERENCE DESIGN</th>
<th>PROPOSED DESIGN</th>
</tr>
</thead>
<tbody>
<tr>
<td>Air exchange rate</td>
<td>The air leakage rate at a pressure of 0.2 inch w.g. (50 Pa) shall be:</td>
<td>The measured air exchange rate.(^a)</td>
</tr>
<tr>
<td></td>
<td>Climate Zones 1 and 2: 5 air changes per hour for spaces with ducted heating and cooling systems; 4 air changes per hour for non-ducted heating and cooling systems. Climate Zones 3 through 8: 3 air changes per hour for spaces with ducted heating and cooling systems; 2 air changes per hour for non-ducted heating and cooling systems.</td>
<td>The mechanical ventilation rate shall be in addition to the air leakage rate and shall be as proposed.</td>
</tr>
<tr>
<td></td>
<td>The mechanical ventilation rate shall be in addition to the air leakage rate and shall be the same as in the proposed design, but not greater than (0.01 \times \text{CFA} + 7.5 \times (N_B + 1))</td>
<td></td>
</tr>
<tr>
<td></td>
<td>where:</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(\text{CFA} = \text{conditioned floor area, ft}^2).</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(N_B = \text{number of bedrooms}).</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Energy recovery shall not be assumed for mechanical ventilation.</td>
<td></td>
</tr>
</tbody>
</table>

For SI: 1 square foot = 0.93 m\(^2\), 1 British thermal unit = 1055 J, 1 pound per square foot = 4.88 kg/m\(^2\), 1 gallon (US) = 3.785 L, 1 degree = 0.79 rad.

\(^a\) \(\text{C} = (\text{°F}-32)/1.8, \text{1 degree} = 0.79 \text{ rad}\).  

- Where required by the code official, testing shall be conducted by an approved party. Hourly calculations as specified in the ASHRAE Handbook of Fundamentals, or the equivalent, shall be used to determine the energy loads resulting from infiltration.

**Reason:** Energy losses through ductwork are recognized as significant and come from two distinct sources; air lost through ductwork to the outside and, separately, induced infiltration/exfiltration caused by duct pressurization. Air lost to the outside is self-explanatory and is, in fact, already recognized by the 2015 IECC (and earlier versions) in Table R405.5.2(2) where distribution system efficiency is discounted under certain common conditions. In addition, there is growing recognition that ductwork design can have a significant impact on infiltration/exfiltration. On this basis, a reasonable person could conclude that, all other things being held constant, a non-ducted ERH systems would consume less energy than a ducted electric furnace. This proposal recognized the reduced infiltration impact of using non-ducted space heating.

**Cost Impact:** The code change proposal will not increase or decrease the cost of construction. This proposal imposes no additional requirement and, thus, does not add costs.
2018 International Energy Conservation Code

Revise as follows:

**TABLE R405.5.2(1) [IRC N1105.5.2(1)]**

**SPECIFICATIONS FOR THE STANDARD REFERENCE AND PROPOSED DESIGNS**

Portions of table not shown remain unchanged.

<table>
<thead>
<tr>
<th>BUILDING COMPONENT</th>
<th>STANDARD REFERENCE DESIGN</th>
<th>PROPOSED DESIGN</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heating systems⁴ ⁵</td>
<td>For other than electric heating without a heat pump: as proposed. Where the proposed design utilizes electric heating without a heat pump, the standard reference design shall be an air source heat pump meeting the requirements of Section C403 of the IECC—Commercial Provisions. Capacity: sized in accordance with Section R403.7.</td>
<td>As proposed</td>
</tr>
</tbody>
</table>

**Exception:** Where the proposed design is for grid-interactive electric thermal storage, the standard reference shall be as proposed.

d. For a proposed design with multiple heating, cooling or water heating systems using different fuel types, the applicable standard reference design system capacities and fuel types shall be weighted in accordance with their respective loads as calculated by accepted engineering practice for each equipment and fuel type present.

e. For a proposed design without a proposed heating system, a heating system having the prevailing federal minimum efficiency shall be assumed for both the standard reference design and proposed design.

**SECTION R202 (IRC N1101.6)**

**GENERAL DEFINITIONS**

Add new definition as follows:

**GRID-INTERACTIVE ELECTRICAL THERMAL STORAGE (GETS).** An energy storage system that provides electric system grid operators (utilities, ISO’s, RTO’s, etc) with variable control of a building’s space and water heating end uses to assist in the real-time balancing of energy supply and demand on the electric grid and integration of renewable energy from solar and wind while providing low cost space and water heat for consumers.

**Reason:** GRID-Interactive Electric Thermal Storage (GETS) is an energy storage system that provides electric system grid operators (utilities, ISO’s, RTO’s, etc) with variable control of a building’s space and water heating end uses to assist in the real-time balancing of energy supply and demand on the electric grid and integration of renewable energy from solar and wind while providing low cost space and water heat for consumers.

**Cost Impact:** The code change proposal will not increase or decrease the cost of construction.

This proposal imposes no additional requirement and, thus, does not add costs.
**Proponent:** Mike Moore, representing Broan-NuTone (mmoore@newportventures.net)

**2018 International Energy Conservation Code**

Revise as follows:

**TABLE R405.5.2(1) [IRC N1105.5.2(1)]**

**SPECIFICATIONS FOR THE STANDARD REFERENCE AND PROPOSED DESIGNS**

Portions of table not shown remain unchanged.

<table>
<thead>
<tr>
<th>BUILDING COMPONENT</th>
<th>STANDARD REFERENCE DESIGN</th>
<th>PROPOSED DESIGN</th>
</tr>
</thead>
<tbody>
<tr>
<td>Air exchange rate</td>
<td>The air leakage rate at a pressure of 0.2 inch w.g. (50 Pa) shall be Climate Zones 1 and 2: 5 air changes per hour. Climate Zones 3 through 8: 3 air changes per hour. The mechanical ventilation rate shall be in addition to the air leakage rate and shall be the same as in the proposed design, but not greater than (0.034 \times \text{CFA} + 7.5 \times (N_{bx} + 1)) where: (\text{CFA} = \text{conditioned floor area, ft}^2). (N_{bx} = \text{number of bedrooms.}) Energy recovery shall not be assumed for mechanical ventilation.</td>
<td>The measured air exchange rate.(^a) The mechanical ventilation rate(^b) shall be in addition to the air leakage rate and shall be as proposed.</td>
</tr>
<tr>
<td>Mechanical ventilation</td>
<td>Where mechanical ventilation is not specified in the proposed design: None Where mechanical ventilation is specified in the proposed design, the annual vent fan energy use, in units of kWh/yr, shall equal: (e_{fr} \times (0.0876 \times \text{CFA} + 65.7 \times (N_{bx} + 1))) where: (e_{fr} = \text{the minimum exhaust fan efficacy, as specified in Table R403.6.1, corresponding to the flow rate of the proposed design} + \text{flow rate of } 0.01 \times \text{CFA} + 7.5 \times (N_{bx} + 1)) CFA = conditioned floor area, ft(^2). (N_{bx} = \text{number of bedrooms.})</td>
<td>As proposed</td>
</tr>
</tbody>
</table>

For SI: 1 square foot = 0.093 m\(^2\), 1 British thermal unit = 1055 J, 1 pound per square foot = 4.88 kg/m\(^2\), 1 gallon (US) = 3.785 L,

\(^{a}C = \left(\frac{\text{°F} - 32}{1.8}\right), 1 \text{ degree} = 0.79 \text{ rad}.

\(^{b}\text{Where required by the code official, testing shall be conducted by an approved party. Hourly calculations as specified in the ASHRAE Handbook of Fundamentals, or the equivalent, shall be used to determine the energy loads resulting from infiltration.}

**Reason:** ASHRAE 62.2 is the ANSI consensus standard for determining the ventilation flow rates needed to provide minimum acceptable indoor air quality. It is well known that ASHRAE 62.2 ventilation rates can be higher than IRC ventilation rates, especially for tight dwelling units. As homes get tighter, ASHRAE's rates go up. On the other hand, the IRC's rates are constant regardless of how tight a dwelling unit is; a home with an air tightness of 0.5 ACH50 would require the same amount of ventilation as a home with an air tightness of 5 ACH50, resulting in drastically fewer air changes for the tight home and putting the tight home at risk for poor indoor air quality. When using the performance path to comply with the IECC (i.e., Table R405.5.2(1)), a high performance home with a tight dwelling unit is penalized for following adjusting its ventilation rate upward to
compensate for the decrease in infiltration air changes. This table should not penalize homes for maintaining minimum IAQ in accordance with ANSI consensus standards. As such, the flow rate for the reference home should still be equal to the proposed design homes flow rate, but should also be capped at the ASHRAE 62.2 rate. Under this scenario, flow rates for the proposed design exceeding the minimum ASHRAE flow rate (based on the simplified compliance path equation of 0.3*CFA + 7.5*(Nbr+1)) will still be penalized for additional energy used.

Cost Impact: The code change proposal will not increase or decrease the cost of construction
This proposal has no bearing on the cost of construction as it does not require builders to size ventilation systems differently. It simply permits builders to not be penalized if electing to set ventilation air flow rates equal to that established within the ANSI consensus standard for minimum acceptable indoor air quality.

Proposal # 5416

RE169-19
TABLE R405.5.2(1) [IRC N1105.5.2(1)]

SPECIFICATIONS FOR THE STANDARD REFERENCE AND PROPOSED DESIGNS

<table>
<thead>
<tr>
<th>BUILDING COMPONENT</th>
<th>STANDARD REFERENCE DESIGN</th>
<th>PROPOSED DESIGN</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heating systems*</td>
<td>For other than forced-air electric heating without a heat pump: as proposed. Where the proposed design utilizes forced-air electric heating without a heat pump, the standard reference design shall be an air source heat pump meeting the requirements of Section C403 of the IECC—Commercial Provisions. Capacity: sized in accordance with Section R403.7. Where the proposed design utilizes non-forced-air electric heating: as proposed.</td>
<td></td>
</tr>
</tbody>
</table>

* C = (°F-32)/1.8, 1 degree = 0.79 rad.

d. For a proposed design with multiple heating, cooling or water heating systems using different fuel types, the applicable standard reference design system capacities and fuel types shall be weighted in accordance with their respective loads as calculated by accepted engineering practice for each equipment and fuel type present.

e. For a proposed design without a proposed heating system, a heating system having the prevailing federal minimum efficiency shall be assumed for both the standard reference design and proposed design.

Reason: As it is written, Table R405.5.2(1) requires a modeler to assume a heat pump system whenever a designer proposes to use "... other than electric heating without a heat pump," i.e., electric resistance or electric radiant heating (collectively "ERH") in a new residence. While perhaps serving a valuable function in some fashion (elimination of gaming where a modeler assumes an electric furnace for the reference house and then proposes a heat pump allowing a less stringent envelope), the limitation on use of ERH in the modeling is overly restrictive. ERH is available in many different applications and the performance characteristics of non-ducted ERH are very different from the performance characteristics of ducted heating systems, whether fueled by electricity, gas, or any other fuel. In addition to no duct energy losses, non-ducted ERH also enjoys significant energy savings from zoning. This proposal attempts to preserve the benefit of eliminating gaming while still recognizing the energy savings potential of non-ducted ERH. In addition, this proposal cites the heat pump specific provisions of the IECC commercial provisions rather than simply citing the commercial chapter.

Substantiation: ERH is available in a number of different configurations, including electric furnace, baseboard, radiant, energy storage and PTAC. For purposes of this proposal, however, only non-ducted ERH is being considered. The operational and energy consumption characteristics of ducted vs. non-ducted ERH are significant and are at the core of the rationale behind this code change proposal. Unfortunately, ducted and non-ducted ERH systems are often grouped together (as they are in the existing code language).

Language like that found currently in Table R405.5.2(1) that requires a modeler to assume a heat pump in the reference house, even if the designer intends to use electric baseboard heating in the proposed house, has been in the IECC for many years. The justification cited historically for that modeling limitation is:

- That modelers will game the system by assuming ERH in the reference house but a heat pump in the proposed house, thereby allowing a less stringent envelope, and/or
- That a heat pump will consume on the order of half the energy of an electric furnace installed in the same house so the code should discourage designers from specifying ERH and instead should specify a heat pump.

With respect to the former of these justifications, the current language requiring the same equipment to be modeled in both the reference and the proposed designs denies any opportunity to game the system as described above.

That leaves the latter as the sole justification for the modeling restriction against using electric resistance heating as the equipment assumption in the
reference house. To some extent, this seems appropriate. If, for instance, in a heating dominated climate, a designer is proposing to install a ducted electric furnace with central air-conditioning, then incenting that designer to use a heat pump instead would probably be expected to save significant amounts of energy at a relatively modest cost.

But there are significant operational and energy consumption characteristics that distinguish **ducted from non-ducted** ERH as described in more detail below.

**Ducted vs. non-ducted heating systems.** Non-ducted ERH has significantly different operational and energy consumption characteristics from ducted heating systems.

**Fan Power.** Numerous studies over the last decade have identified furnace fan energy usage as more significant than before believed. As a result, the U.S. Department of Energy has initiated a rulemaking to establish a test procedure for determining furnace fan energy. Likewise, the Environmental Protection Agency now has an Energy Star rating for efficient furnace fans. Of course, non-ducted ERH like baseboard or radiant doesn't use a fan. On this basis, a reasonable person could conclude that, all other things being held constant, a non-ducted heating system (without a fan) would consume less energy than a ducted system with a fan using the same technology (gas, oil, electric resistance, etc.).

**Duct loss and fan induced infiltration.** Energy losses through ductwork are recognized as significant and come from two distinct sources; air lost through ductwork to the outside and induced infiltration/exfiltration caused by duct pressurization. Air lost to the outside is self-explanatory and is, in fact, already recognized by the 2012 IECC (and earlier versions) in Table R405.5.2(2) where distribution system efficiency is discounted under certain common conditions. In addition, there is growing recognition that ductwork design can have a significant impact on infiltration/exfiltration. On this basis, a reasonable person could conclude that, all other things being held constant, a non-ducted ERH system would consume less energy than a ducted electric furnace.

**Zoning.** Ducted, central heating, whether it be a ducted heat pump, electric furnace, gas furnace or other, is designed to serve large areas, most often an entire house. Non-ducted ERH, on the other hand, generally divides a house up into numerous independently controlled zones. The energy efficiency benefits of zoning are well documented as it allows users to heat only those areas that are occupied resulting in significant savings. On this basis, a reasonable person could conclude that, all other things being held constant, a zoned, non-ducted heating system would consume less energy than a ducted heating system using the same technology (gas, oil, electric resistance, etc.).

**Additional considerations.** Few people would argue that, at the margin, a zoned, non-ducted ERH would be expected to consume fewer btu's over the course of a winter than a ducted electric furnace. In addition to these operational differences, however, (no fan energy, no duct losses, benefits of zoning), there are other reasons why ERH should be treated differently from ducted heating systems as noted below.

**Cooling.** There are still a non-trivial amount of new homes built in the United States every year without central cooling. According to the EIA, over 800,000 new homes were built between 2000 and 2009 without air-conditioning. A recent study in the Pacific Northwest revealed a relationship between increased use of cooling energy in homes that use heat pumps vis-à-vis electric furnaces. While there are a number of potential explanations, at least one explanation is that people using non-ducted ERH consciously decline to install air conditioning. Thus, incenting the use of heat pumps over ERH may have the unintended result of increasing summer cooling energy.

**Cooling dominated climate.** In cooling dominated climates, with relatively few heating degree days (DOE Climate Zones 1 & 2), driving a builder to use a heat pump which would save relatively little – if any – heating energy due to the warm climate would result in fewer dollars for that builder to spend on other things like more attic insulation or higher SEER air-conditioning – something that would actually result in energy savings.

Non-ducted ERH has significantly different operating characteristics than ducted heating systems.

With respect to the assumption that a heat pump system will consume less than half the btus's of an electric resistance heating system because the heat pump has a COP of 2 or better, this assumption may be valid for a comparison between a ducted heat pump and a ducted electric resistance furnace, but it not accurate for non-ducted, zoned ERH (See Note 1 below).

In a study conducted by the National Association of Home Builders Research Center for the U.S. Department of Energy, an occupied house in the Washington, D.C. area was monitored for performance over a winter. The house contained three distinct heating systems; central electric heat pump, electric radiant heat, and electric baseboard heat. After the data was weather normalized, it revealed that, under actual homeowner controlled conditions, the electric radiant system used 33% percent less energy than the heat pump system and 52% less than the electric baseboard system. Thus, the heat pump only saved about 26% the energy consumed by the electric baseboard system.

Heat pumps are a great option when a person wants a central, ducted heating and cooling system but they having different operating characteristics from a non-ducted heating system.

Note 1. Recent field data from a large survey of homes suggests that the actual (vs. theoretical) relationship may not be as well understood as previously believed. See study at [http://www.nwcouncil.org/energy/rtf/meetings/2009/04/Draft%202008%20NEEM%20Study_040608.pdf](http://www.nwcouncil.org/energy/rtf/meetings/2009/04/Draft%202008%20NEEM%20Study_040608.pdf) (p. 21) where observed heat pump energy savings were far short of expectations and the report said...
“For the heat pump cases, however, the apparent similarity between electric resistance and heat pump systems suggest minimal savings for the more efficient heat pump option. Some form of behavioral —takeback‖, poor heat pump installations or increased summer cooling load for heat pumps vis-à-vis resistance houses seem the likeliest explanations. Given that a number of the zone 1 sites (e.g.: Medford, Oregon; Yakima, Washington; and The Dalles, Oregon), have cooling climates, the latter seems plausible. A possible alternate contributing explanation is that these heat pump units do not in fact achieve an average COP of as much as 2 under actual operating conditions. Field notes from heat pump cases in the Oregon sample (a high percentage of heat pumps) mentioned occupants who complained about a lack of comfort to their heating contractor and were told by their heating contractors to switch the heat pumps to run in electric resistance heating mode.”


For an Alliance to Save Energy video on the benefits of zoning see http://www.energynow.com/video/2011/11/16/home-efficiency-tips-heating-and-cooling-zones where the moderator quotes the Department of Energy as saying that zoning can save up to 30% on home heating and cooling bills.


**Cost Impact:** The code change proposal will not increase or decrease the cost of construction
This proposal imposes no additional requirement and, thus, does not add costs.

Cost Impact: The code change proposal will not increase or decrease the cost of construction
This proposal imposes no additional requirement and, thus, does not add costs.

Proposal # 4081

RE170-19
**2018 International Energy Conservation Code**

Revise as follows:

**TABLE R405.5.2(1) [IRC N1105.5.2(1)]**

**SPECIFICATIONS FOR THE STANDARD REFERENCE AND PROPOSED DESIGNS**

Portions of table not shown remain unchanged.

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<th>BUILDING COMPONENT</th>
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</tr>
</thead>
<tbody>
<tr>
<td>Duct insulation:</td>
<td>in accordance with Section R403.3.1.</td>
<td>Duct insulation: as proposed.</td>
</tr>
<tr>
<td>Thermal</td>
<td>A thermal distribution system efficiency (DSE) of 0.88 shall be applied to both the heating and cooling system efficiencies. For all systems other than tested duct systems.</td>
<td>As tested or, where not tested, as specified in Table R405.5.2(2)</td>
</tr>
<tr>
<td>Exception: For nonducted heating and cooling systems that do not have a fan, the standard reference design thermal distribution system efficiency (DSE) shall be 1.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>For tested duct systems, the leakage rate shall be 4 cfm (113.3 L/min) per 100 ft² (9.29 m²) of conditioned floor area at a pressure differential of 0.1 inch w.g. (25 Pa).</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

For SI: 1 square foot = 0.93 m², 1 British thermal unit = 1055 J, 1 pound per square foot = 4.88 kg/m², 1 gallon (US) = 3.785 L,

° C = (° F-32)/1.8, 1 degree = 0.79 rad.
RE172-19
IECC: R405.5.2.(1) [IRC N1105.5.2(1)]

Proponent: Robby Schwarz, EnergyLogic, representing EnergyLogic (robby@nrglogic.com); Chris McTaggart, representing Building Efficiency Resources (cmctaggart@theber.com); Shaunna Mozingo (sdmozingo@shaunnamozingo.com)

2018 International Energy Conservation Code
Revise as follows:

TABLE R405.5.2(1) [IRC N1105.5.2(1)]
SPECIFICATIONS FOR THE STANDARD REFERENCE AND PROPOSED DESIGNS

Portions of table not shown remain unchanged.

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</tr>
</thead>
<tbody>
<tr>
<td>Thermal distribution systems</td>
<td>Duct insulation: in accordance with Section R403.3.1. A thermal distribution system efficiency (DSE) of 0.88 shall be applied to both the heating and cooling system efficiencies for all systems other than tested duct systems. Duct location: same as proposed design. Exception: For nonducted heating and cooling systems that do not have a fan, the standard reference design thermal distribution system efficiency (DSE) shall be 1. For tested duct systems, the leakage rate shall be 4 cfm (113.3 L/min) per 100 ft² (9.29 m²) of conditioned floor area at a pressure of differential of 0.1 inch w.g. (25 Pa).</td>
<td>Duct insulation: as proposed. Duct location: as proposed As tested or, where not tested, as specified in Table R405.5.2(2)</td>
</tr>
</tbody>
</table>

For SI: 1 square foot = 0.93 m², 1 British thermal unit = 1055 J, 1 pound per square foot = 4.88 kg/m², 1 gallon (US) = 3.785 L, °C = (°F-32)/1.8, 1 degree = 0.79 rad.

Reason: Duct location plays a significant role in the energy performance of the HVAC distribution system yet the location has not been specifically called out in the specification for the standard reference and proposed design. Most software that I am aware of that model for compliance using the Simulated Performance path interpret the model to include duct location so this addition to the language of the specification justifies that modeling interpretation. In addition, the modeling software models the energy penalty associated with duct leakage to outside not total duct leakage. The additional language of this proposal makes it clear which duct leakage test is being used in the modeling.

Cost Impact: The code change proposal will not increase or decrease the cost of construction. There is no cost impact to the language clarification that is offered through the adoption of this proposal.

Proposal # 5279
2018 International Energy Conservation Code

Revise as follows:

### TABLE R405.5.2(1) [IRC N1105.5.2(1)]

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Portions of table not shown remain unchanged.

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<tr>
<th>BUILDING COMPONENT</th>
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<th>PROPOSED DESIGN</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dehumidistat</td>
<td>Where a mechanical ventilation system with latent heat recovery is not specified in the proposed design: None.</td>
<td>Same as standard reference design.</td>
</tr>
<tr>
<td></td>
<td>Where the proposed design utilizes a mechanical ventilation system with latent heat recovery:</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Dehumidistat type: Manual, setpoint = 60% relative humidity.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Dehumidifier: whole-home with integrated energy factor = 1.77 liters/kWh.</td>
<td></td>
</tr>
</tbody>
</table>

For SI: 1 square foot = 0.93 m², 1 British thermal unit = 1055 J, 1 pound per square foot = 4.88 kg/m², 1 gallon (US) = 3.785 L,

°C = (°F - 32)/1.8, 1 degree = 0.79 rad.

- a. Where required by the code official, testing shall be conducted by an approved party. Hourly calculations as specified in the ASHRAE Handbook of Fundamentals, or the equivalent, shall be used to determine the energy loads resulting from infiltration.
- c. Thermal storage element shall mean a component that is not part of the floors, walls or ceilings that is part of a passive solar system, and that provides thermal storage such as enclosed water columns, rock beds, or phase-change containers. A thermal storage element shall be in the same room as fenestration that faces within 15 degrees (0.26 rad) of true south, or shall be connected to such a room with pipes or ducts that allow the element to be actively charged.
- d. For a proposed design with multiple heating, cooling or water heating systems using different fuel types, the applicable standard reference design system capacities and fuel types shall be weighted in accordance with their respective loads as calculated by accepted engineering practice for each equipment and fuel type present.
- e. For a proposed design without a proposed heating system, a heating system having the prevailing federal minimum efficiency shall be assumed for both the standard reference design and proposed design.
- f. For a proposed design home without a proposed cooling system, an electric air conditioner having the prevailing federal minimum efficiency shall be assumed for both the standard reference design and proposed design.
- g. For a proposed design with a nonstorage-type water heater, a 40-gallon storage-type water heater having the prevailing federal minimum energy factor for the same fuel as the predominant heating fuel type shall be assumed. For a proposed design without a proposed water heater, a 40-gallon storage-type water heater having the prevailing federal minimum efficiency for the same fuel as the predominant heating fuel type shall be assumed for both the proposed design and standard reference design.
- h. For residences with conditioned basements, R-2 and R-4 residences, and for townhouses, the following formula shall be used to determine glazing area:

$$AF = A_s \times FA \times F$$

where:

- $AF$ = Total glazing area.
- $A_s$ = Standard reference design total glazing area.
- $FA = (Above\text{-}grade \text{ thermal boundary gross wall area})/(above\text{-}grade \text{ boundary wall area} + 0.5 \times \text{below}\text{-}grade \text{ boundary wall area})$.
- $F = (above\text{-}grade \text{ thermal boundary wall area})/(above\text{-}grade \text{ thermal boundary wall area} + \text{common wall area})$ or 0.56, whichever is
and where:

Thermal boundary wall is any wall that separates conditioned space from unconditioned space or ambient conditions.

Above-grade thermal boundary wall is any thermal boundary wall component not in contact with soil.

Below-grade boundary wall is any thermal boundary wall in soil contact.

Common wall area is the area of walls shared with an adjoining dwelling unit.

$L$ and $CFA$ are in the same units.

**Reason:** Addressing latent loads associated with ventilation air can require a large amount of energy, especially in humid climates. Specification of energy recovery ventilators (ERVs) for mechanical ventilation can reduce the latent loads associated with ventilation air; however, there is no way to account for the ability of ERVs to reduce latent loads of ventilation air within Table N1105.5.2(1). This proposal establishes a method for accounting for the latent energy savings of ERVs where specified in the proposed design. A target of 60% relative humidity is typical for the upper bound in residential applications; above this level, there can be problems associated with moisture and condensation, negatively affecting building durability and indoor air quality; using a setpoint below this level can significantly increase energy use of the dehumidifier (and perhaps over-emphasize the benefit of ERVs in typical residential applications). The energy factor used for the dehumidifier (1.77 liters/kWh) is identical to the minimum value listed in the code of federal regulations (10 CFR 430.32) for typical whole-home dehumidifiers (i.e., those with a case volume < 8 ft³).

**Cost Impact:** The code change proposal will decrease the cost of construction. Where ERVs are specified, this measure can reduce the cost of construction by reducing the annual energy costs associated with the proposed design and permitting more flexibility in design.

Proposal # 5336

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RE173-19
2018 International Energy Conservation Code

Revise as follows:

**TABLE R405.5.2(1) [IRC N1105.5.2(1)]**

SPECIFICATIONS FOR THE STANDARD REFERENCE AND PROPOSED DESIGNS

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<th>BUILDING COMPONENT</th>
<th>STANDARD REFERENCE DESIGN</th>
<th>PROPOSED DESIGN</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mechanical ventilation</td>
<td>Where mechanical ventilation is not specified in the proposed design: None</td>
<td>As proposed</td>
</tr>
<tr>
<td></td>
<td>Where mechanical ventilation is specified in the proposed design, the annual vent fan energy use, in units of kWh/yr, shall equal:</td>
<td>Use, in units of kWh/yr = 0.365 x W x H x (CFM required / CFM proposed)</td>
</tr>
<tr>
<td></td>
<td>(e_i) x [0.0876 x CFA + 65.7 x (N_{tr} + 1)]</td>
<td>Where:</td>
</tr>
<tr>
<td></td>
<td>where:</td>
<td>W = fan watts of proposed mechanical ventilation fan</td>
</tr>
<tr>
<td></td>
<td>e_i = the minimum exhaust fan efficacy, as specified in Table R403.6.1, corresponding to a flow rate of 0.01 x CFA + 7.5 x (N_{tr}+1)</td>
<td>H = hours per day that the mechanical ventilation fan is proposed to run.</td>
</tr>
<tr>
<td></td>
<td>CFA = conditioned floor area, ft².</td>
<td>CFM required = (0.01 x CFA + 7.5 x (N_{tr}+1))</td>
</tr>
<tr>
<td></td>
<td>N_{tr} = number of bedrooms.</td>
<td>CFA = conditioned floor area, ft²</td>
</tr>
</tbody>
</table>

For SI: 1 square foot = 0.93 m², 1 British thermal unit = 1055 J, 1 pound per square foot = 4.88 kg/m², 1 gallon (US) = 3.785 L,

\[ ^{\circ}C = \frac{({}^\circ F - 32)}{1.8}, \text{ 1 degree} = 0.79 \text{ rad.} \]

**Reason:** The design of the mechanical ventilation system can have a large impact on the energy performance of a dwelling. This impact is not included in the Performance Path however and as a result there is no difference in the between using a 20 watt exhaust fan or 600 watt AHU to deliver 50 CFM of air. As the minimum efficiencies of mechanical ventilation systems are not governed by NAECA and efficiency floors are already included in the IECC in R403.6 it seems reasonable to include potential efficiency gains based on design selection in the Performance Path similar to the Air exchange rate and Thermal distribution systems.

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

By allowing mechanical ventilation systems to be modeled appropriately, correct (and smaller) equipment sizes will lower construction costs
Proponent: Joel Martell, representing National Association of Home Builders (jmartell@nahb.org)

2018 International Energy Conservation Code

Revise as follows:

R405.2 (IRC N1105.2) Mandatory requirements. Compliance with this section requires that the mandatory provisions identified in Section R401.2 be met. The proposed total building thermal envelope UA, which is the sum of U-factor times the assembly area shall be less than or equal to the UA of the building thermal envelope using the prescriptive U-factors from Table R402.1(4) multiplied by 1.15 in accordance with Equation 4-1. All supply and return ducts not completely inside the building thermal envelope shall be insulated to an R-value of not less than R-6.

Equation 4-1: \( UA_{\text{prop}} \leq 1.15 \times UA_{\text{prescriptive design}} \)

### TABLE R405.5.2(1) [IRC N1105.2(1)]

#### SPECIFICATIONS FOR THE STANDARD REFERENCE AND PROPOSED DESIGNS

Portions of table not shown remain unchanged.

<table>
<thead>
<tr>
<th>BUILDING COMPONENT</th>
<th>STANDARD REFERENCE DESIGN</th>
<th>PROPOSED DESIGN</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heating systems</td>
<td>For other than electric heating without a heat pump, as proposed. Where the proposed design utilizes electric heating without a heat pump, the standard reference design shall be an air-source heat pump meeting the requirements of Section C403 of the IECC—Commercial Provisions.</td>
<td>As proposed</td>
</tr>
<tr>
<td>Capacity: sized in accordance with Section R403.7.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fuel Type/ Capacity: Same as proposed design</td>
<td></td>
<td>As Proposed</td>
</tr>
<tr>
<td>Product class: Same as proposed design</td>
<td></td>
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</tr>
<tr>
<td>Efficiencies:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Heat pump: Complying with 10 CFR §430.32 (2018)</td>
<td></td>
<td>As Proposed</td>
</tr>
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<td>Furnaces: Complying with 10 CFR §430.32 (2018)</td>
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<td>Boilers: Complying with 10 CFR §430.32 (2018)</td>
<td></td>
<td>As Proposed</td>
</tr>
<tr>
<td>Cooling systems</td>
<td>As proposed. Capacity: sized in accordance with Section R409.7.</td>
<td>As proposed</td>
</tr>
<tr>
<td>Fuel Type/ Capacity: Same as proposed design</td>
<td></td>
<td>As Proposed</td>
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<tr>
<td>Efficiencies: Complying with 10 CFR §430.32 (2018)</td>
<td></td>
<td>As Proposed</td>
</tr>
<tr>
<td>Service water heating</td>
<td>As proposed. Use: same as proposed design.</td>
<td>As proposed</td>
</tr>
<tr>
<td>Fuel Type: Same as proposed design</td>
<td></td>
<td>As proposed</td>
</tr>
<tr>
<td>Rated Storage Volume: Same as proposed design</td>
<td></td>
<td>As proposed</td>
</tr>
<tr>
<td>Draw Pattern: Same as proposed design</td>
<td></td>
<td>As proposed</td>
</tr>
<tr>
<td>Efficiencies: Uniform Energy Factor complying with 10 CFR §430.32 (2018)</td>
<td></td>
<td>As proposed</td>
</tr>
<tr>
<td>Use: gal/day = 30 + 10 x Nbr</td>
<td></td>
<td>Same as standard reference</td>
</tr>
<tr>
<td>Tank temperature: 120 °F</td>
<td></td>
<td>Same as standard reference</td>
</tr>
</tbody>
</table>

For SI: 1 square foot = 0.093 m², 1 British thermal unit = 1055 J, 1 pound per square foot = 4.88 kg/m², 1 gallon (US) = 3.785 L.

\(^{\circ}C = \left( ^{\circ}F - 32 \right)/1.8, 1 \text{ degree} = 0.79 \text{ rad.}\)
a. Where required by the code official, testing shall be conducted by an approved party. Hourly calculations as specified in the ASHRAE Handbook of Fundamentals, or the equivalent, shall be used to determine the energy loads resulting from infiltration.


c. Thermal storage element shall mean a component that is not part of the floors, walls or ceilings that is part of a passive solar system, and that provides thermal storage such as enclosed water columns, rock beds, or phase-change containers. A thermal storage element shall be in the same room as fenestration that faces within 15 degrees (0.26 rad) of true south, or shall be connected to such a room with pipes or ducts that allow the element to be actively charged.

d. For a proposed design with multiple heating, cooling or water heating systems using different fuel types, the applicable standard reference design system capacities and fuel types shall be weighted in accordance with their respective loads as calculated by accepted engineering practice for each equipment and fuel type present.

e. For a proposed design without a proposed heating system, a heating system having the prevailing federal minimum efficiency shall be assumed for both the standard reference design and proposed design.

f. For a proposed design home without a proposed cooling system, an electric air conditioner having the prevailing federal minimum efficiency shall be assumed for both the standard reference design and the proposed design.

g. For a proposed design with a nonstorage-type water heater, a 40 gallon storage-type water heater having the prevailing federal minimum energy factor for the same fuel as the predominant heating fuel type shall be assumed. For a proposed design without a proposed water heater, a 40 gallon storage-type water heater having the prevailing federal minimum efficiency for the same fuel as the predominant heating fuel type shall be assumed the following assumptions shall be made for both the proposed design and standard reference design.

Fuel Type: Same as the predominant heating fuel type
Rated Storage Volume: 40 Gallons

h. For residences with conditioned basements, R-2 and R-4 residences, and for townhouses, the following formula shall be used to determine glazing area:

\[ AF = A_s \times FA \times F \]

where:

\[ AF = \text{Total glazing area.} \]
\[ A_s = \text{Standard reference design total glazing area.} \]
\[ FA = \frac{(\text{Above-grade thermal boundary gross wall area})}{(\text{above-grade boundary wall area} + 0.5 \times \text{below-grade boundary wall area})}. \]
\[ F = \frac{(\text{above-grade thermal boundary wall area})}{(\text{above-grade thermal boundary wall area} + \text{common wall area})} \text{ or 0.56, whichever is greater.} \]

and where:

- Thermal boundary wall is any wall that separates conditioned space from unconditioned space or ambient conditions.
- Above-grade thermal boundary wall is any thermal boundary wall component not in contact with soil.
- Below-grade boundary wall is any thermal boundary wall in soil contact.
- Common wall area is the area of walls shared with an adjoining dwelling unit.

\[ L \text{ and } CFA \text{ are in the same units.} \]


Reason: This proposal includes energy neutral trade-offs for equipment efficiency, but also includes a reasonable thermal envelope through the addition of a UA backstop. The ERI compliance path reintroduced equipment efficiencies as part of energy neutral trade-offs and also included a new concept of requiring a reasonable minimum thermal envelope in a performance-type analysis. This proposal takes this “reasonable envelope” concept and applies it to the Simulated Performance Alternative (Section 405). However, rather than pointing to the prescriptive tables in a previous version of the IECC as is done in the ERI, the thermal backstop becomes a percent UA trade-off. The UA calculation will be performed internally with the compliance software. It is an easy calculation as all the necessary information is already entered (component area and U-factors/R-values).

This should not be problematic as it is already done for windows. Energy neutral equipment trade-offs had been in the IECC residential section for years. Equipment trade-offs are included in every other energy code/standard and above code program in the United States: IECC Commercial.
The fear that has been spread with bringing back equipment trade-offs is that the envelope will be substandard. The proposed UA trade-off of 15% considered a reasonable envelope backstop. Quite often, the use of this high-efficiency equipment provides a more cost-effective solution to achieve code compliance. Eliminating this ability discourages the concept of the "house as a system" approach, which is a cornerstone of building science.

**Cost Impact:** The code change proposal will not increase or decrease the cost of construction. This will help achieve higher performing dwellings while adding flexibility.
### 2018 International Energy Conservation Code

Revise as follows:

**TABLE R405.5.2(1) [IRC N1105.5.2(1)]**

**SPECIFICATIONS FOR THE STANDARD REFERENCE AND PROPOSED DESIGNS**

Portions of table not shown remain unchanged.

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<th>BUILDING COMPONENT</th>
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<td><strong>Heating systems</strong>&lt;sup&gt;d, e&lt;/sup&gt;</td>
<td>For other than electric heating without a heat pump: as proposed. Where the proposed design utilizes electric heating without a heat pump, the standard reference design shall be an air source heat pump meeting the requirements of Section C403 of the IECC—Commercial Provisions.</td>
<td>As proposed</td>
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<td></td>
<td>Capacity: sized in accordance with Section R403.7.</td>
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</tr>
<tr>
<td></td>
<td>Fuel Type/ Capacity: Same as proposed design</td>
<td>As Proposed</td>
</tr>
<tr>
<td></td>
<td>Product class: As proposed</td>
<td>As Proposed</td>
</tr>
<tr>
<td></td>
<td>Efficiencies:</td>
<td>As Proposed</td>
</tr>
<tr>
<td></td>
<td>Heat pump: Complying with Subpart C of 10 CFR 430.32 (2021)</td>
<td>As Proposed</td>
</tr>
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<td>Furnaces: Complying with Subpart C of 10 CFR 430.32 (2021)</td>
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<td></td>
<td>Boilers: Complying with Subpart C of 10 CFR 430.32 (2021)</td>
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</tr>
<tr>
<td><strong>Cooling systems</strong>&lt;sup&gt;d, f&lt;/sup&gt;</td>
<td>As proposed. Capacity: sized in accordance with Section R403.7.</td>
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</tr>
<tr>
<td></td>
<td>Fuel Type/ Capacity: Same as proposed design</td>
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<td>Efficiencies: Complying with Subpart C of 10 CFR 430.32 (2021)</td>
<td>As Proposed</td>
</tr>
<tr>
<td><strong>Service water heating</strong>&lt;sup&gt;d, e, g&lt;/sup&gt;</td>
<td>As proposed. Use: same as proposed design.</td>
<td>As Proposed</td>
</tr>
<tr>
<td></td>
<td>Fuel Type: Same as proposed design. Subpart C of 10 CFR 430.32 (2021)</td>
<td>Use, in units of gal/day = 30 + (10 × Nbr)</td>
</tr>
<tr>
<td></td>
<td>Efficiencies: Uniform Energy Factor</td>
<td>where:</td>
</tr>
<tr>
<td></td>
<td>Use: gal/day = 30 + 10 x Nbr</td>
<td>Nbr = number of bedrooms.</td>
</tr>
<tr>
<td></td>
<td>Tank temperature: 120 °F</td>
<td>As Proposed</td>
</tr>
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</table>

For SI: 1 square foot = 0.93 m², 1 British thermal unit = 1055 J, 1 pound per square foot = 4.88 kg/m², 1 gallon (US) = 3.785 L,

<sup>°C = (°F-32)/1.8, 1 degree = 0.79 rad.</sup>
For a proposed design with multiple heating, cooling or water heating systems using different fuel types, the applicable standard reference design system capacities and fuel types shall be weighted in accordance with their respective loads as calculated by accepted engineering practice for each equipment and fuel type present.

e. For a proposed design without a proposed heating system, a heating system having the prevailing federal minimum efficiency shall be assumed for both the standard reference design and proposed design.

f. For a proposed design home without a proposed cooling system, an electric air conditioner having the prevailing federal minimum efficiency shall be assumed for both the standard reference design and the proposed design.

g. For a proposed design with a nonstorage-type water heater: A 40-gallon storage-type water heater having the prevailing federal minimum energy factor for the with the same fuel as the predominant heating fuel type shall be assumed. For a proposed design without a proposed water heater, a 40-gallon storage-type water heater having the prevailing federal minimum efficiency for the same fuel as the predominant heating fuel type shall be assumed for both the proposed design and standard reference design, assumed for the standard reference design. The minimum uniform energy factor shall be selected based on the Medium draw pattern found in Subpart C of 10 CFR 430.32 (2021). This water heater shall be used for the proposed water heater in the case of a proposed design without a proposed water heater.

Add new standard(s) as follows:

10 CFR, Part 431: Energy Efficiency Program for Certain Commercial and Industrial Equipment: Test Procedures and Efficiency Standards; Final Rules

Reason: Equipment efficiency is a key part of home energy efficiency. This proposal restores equipment efficiency to the performance calculation. This proposal also corrects a long-standing error in the code, that of citing “prevailing federal minimum efficiency”.

The code’s use of “prevailing federal minimum efficiency” is inappropriate and may hamper adoption. Yes, this language has been used for some time and is currently in three existing table footnotes, footnotes “e”, “f” and “g”. However, “prevailing” creates a problem. When states, counties and cities adopt laws, they are obligated to make the exact content of the law available to the public. When the ‘prevailing’ federal minimum efficiency changes; the jurisdiction’s code also changes automatically. Changing the “prevailing” standard without any jurisdictional process means another body, which is not the legislative body of the jurisdiction, changes the laws within the jurisdiction without any public hearing or vote by the local legislative body. This is called an illegal delegation of legislative authority. This is why I-code referenced standards always come with a date/edition (see the referenced standard chapter). The I-codes don’t reference any old edition of a standard, they reference a specific edition of that standard.

The other problem with simply saying ‘prevailing federal minimum efficiency’ is that it doesn’t tell the designer or the code official where to find those values. The solution is to cite the specific Federal law and date, just as is done with any standard referenced in the I-codes. Yes – this does lock in the efficiency standard used for 3 years. But that is what we do for every other standard.

Equipment efficiency is a key part of home energy efficiency. More efficient equipment saves more energy. Significant energy savings is available for every type of equipment efficiency. A high-efficiency 95 AFUE furnace saves energy. A high-efficiency 19 SEER air conditioner saves energy. Ground source heat pumps save considerable energy. Solar water heating saves energy. Homes that use more efficient equipment should get credit for choosing more efficient equipment. Equipment efficiency was a part of the residential IECC performance calculation in 2006 and prior. Equipment efficiency is part of the commercial IECC performance calculation, ASHRAE 90.1 and 90.2, to name a few.

Some argue that longer-life measures should not be traded for shorter-life measures. For example, don’t trade lower wall insulation for higher equipment efficiency. However the ERI allows one to trade higher-efficiency refrigerators, higher-efficiency clothes washers and higher-efficiency dishwashers for lower wall insulation. Clothes washers in particular are often moved with the owner when a house is sold. The lifetime of windows is less than insulation, should we allow better windows to be traded for lower wall insulation? I’d argue to keep all tradeoffs. However, if one argues to keep equipment efficiency tradeoffs out of Section R405 performance trades, then to be consistent one should also argue to keep equipment efficiency, refrigerators, clothes washers and dishwashers out of the tradeoffs for insulation in the ERI.

Why was equipment efficiency taken out of after the 2006 residential IECC? In the proponent’s opinion one reason was to protect the market for some types of products that thought equipment efficiency might compete and reduce their market share. For instance, some might use high
efficiency equipment instead of higher levels of insulation. The goal of the code should be to deliver energy efficiency, not to protect products.

Moving to even higher levels of energy efficiency in the code will require restoring flexibility, part of which is equipment efficiency. If builders get credit for what they do, be it equipment efficiency, solar, or whatever, then this proponent is comfortable asking them to achieve higher levels of efficiency, even increasing requirements through code. However, without flexibility, then builders need more exceptions and lesser requirements to make up for the flexibility they are denied by code. Without restoring flexibility, additional energy efficiency in code is much more difficult to achieve.

**Cost Impact:** The code change proposal will decrease the cost of construction
Allowing credit for high efficiency equipment will encourage energy efficiency and promote lower cost ways to get to energy efficient homes.

**Staff Analysis:** A review of the standard proposed for inclusion in the code, 10 CFR 430.32 (2021), with regard to the ICC criteria for referenced standards (Section 3.6 of CP#28) will be posted on the ICC website on or before April 2, 2019.
RE177-19

IECC: TABLE R405.5.2(1) [IRC N1105.5.2(1)]

Proponent: Joseph Hill, NYSDOS, representing NYSDOS (Joseph.Hill@dos.ny.gov); John Addario, New York State Department of State, representing New York State Department of State (john.addario@dos.ny.gov)

2018 International Energy Conservation Code

Revise as follows:

**TABLE R405.5.2(1) [IRC N1105.5.2(1)]**

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<tbody>
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<td>Air exchange rate</td>
<td>The air leakage rate at a pressure of 0.2 inch w.g. (50 Pa) shall be Climate Zones 1 and 2: 5 air changes per hour. Climate Zones 3 through 8: 3 air changes per hour. The mechanical ventilation rate shall be in addition to the air leakage rate and shall be the same as in the proposed design, but not greater than $0.03 \times CFA + 7.5 \times (N_v + 1)$ where: $CFA =$ conditioned floor area, ft$^2$. $N_v =$ number of bedrooms. Energy recovery shall not be assumed for mechanical ventilation.</td>
<td>The measured air exchange rate.$^a$ The mechanical ventilation rate$^b$ shall be in addition to the air leakage rate and shall be as proposed.</td>
</tr>
<tr>
<td>Mechanical ventilation</td>
<td>Where mechanical ventilation is not specified in the proposed design: None Where mechanical ventilation is specified in the proposed design, the annual vent fan energy use, in units of kWh/yr, shall equal: $(U_{e1}) \times [0.0875 \times CFA + 65.7 \times (N_v + 1)]$ where: $e_1 =$ the minimum exhaust fan efficacy, as specified in Table R403.6.1, corresponding to a flow rate of $0.03 \times CFA + 7.5 \times (N_v + 1)$ $CFA =$ conditioned floor area, ft$^2$. $N_v =$ number of bedrooms.</td>
<td>As proposed</td>
</tr>
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</table>

For SI: 1 square foot = 0.93 m$^2$, 1 British thermal unit = 1055 J, 1 pound per square foot = 4.88 kg/m$^2$, 1 gallon (US) = 3.785 L, $^a$ C = ($^*F$ - 32)/1.8, 1 degree = 0.79 rad.

a. Where required by the code official, testing shall be conducted by an approved party. Hourly calculations as specified in the ASHRAE Handbook of Fundamentals, or the equivalent, shall be used to determine the energy loads resulting from infiltration.
c. Thermal storage element shall mean a component that is not part of the floors, walls or ceilings that is part of a passive solar system, and that provides thermal storage such as enclosed water columns, rock beds, or phase-change containers. A thermal storage element shall be in the same room as fenestration that faces within 15 degrees (0.26 rad) of true south, or shall be connected to such a room with pipes or ducts that allow the element to be actively charged.
d. For a proposed design with multiple heating, cooling or water heating systems using different fuel types, the applicable standard reference design system capacities and fuel types shall be weighted in accordance with their respective loads as calculated by accepted engineering practice for each equipment and fuel type present.
e. For a proposed design without a proposed heating system, a heating system having the prevailing federal minimum efficiency shall be assumed for both the standard reference design and proposed design.
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h. For residences with conditioned basements, R-2 and R-4 residences, and for townhouses, the following formula shall be used to determine glazing area:

\[ AF = A_s \times FA \times F \]

where:

AF = Total glazing area.

A_s = Standard reference design total glazing area.

FA = \((\text{above-grade thermal boundary gross wall area})/(\text{above-grade boundary wall area} + 0.5 \times \text{below-grade boundary wall area})\).

F = \((\text{above-grade thermal boundary wall area})/(\text{above-grade thermal boundary wall area} + \text{common wall area})\) or 0.56, whichever is greater.

and where:

Thermal boundary wall is any wall that separates conditioned space from unconditioned space or ambient conditions.

Above-grade thermal boundary wall is any thermal boundary wall component not in contact with soil.

Below-grade boundary wall is any thermal boundary wall in soil contact.

Common wall area is the area of walls shared with an adjoining dwelling unit.

L and CFA are in the same units.

Reason: In 2012, the IRC and IECC were modified introducing "Whole House Mechanical Ventilation" which was required in one and two family dwelling units and townhouse construction, when tested to less than 5 ACH 50. This is essentially all such buildings as described. ASHRAE 62.2004 was used as a basis for the rate of ventilation, which designated the ventilation rate of whole house ventilation at \( Q \text{ fan} = 0.01A \text{ floor} + 7.5 (BR + 1) \). This version, as according to the the 2012 IRC Code and Commentary. The more recent versions of ASHRAE 62.2-(2013 / 2016.) have recognized the need to improve indoor air quality, have revised the rate of ventilation to Mechanical Ventilation \( Q \text{ fan} = 0.03A \text{ floor} + 7.5 (BR + 1) \). This was done because the prior rate assumed a significant amount of outdoor air from infiltration, which due to improvements in the IECC, has steadily dropped, necessitating an increase in the mechanical ventilation rate. It is therefore not appropriate in 2019 to still be referencing ventilation rates from those outdated standards. This revised rate = 0.03A floor + 7.5 (BR + 1) is also contained in ANSI/RESNET ICC-2014 which sets R406.3 Energy rating index at odds with itself, since there was a modification to the IECC code text of this section setting the ventilation rate back to \( Q \text{ fan} = 0.01A \text{ floor} + 7.5 (BR + 1) \). This issue will likely be the focus of a code change proposal by the authors of the RESNET standard.

Bibliography: 2018 IECC

Cost Impact: The code change proposal will not increase or decrease the cost of construction

The proposal modifies the rate of mechanical ventilation to be consistent with ANSI/RESNET/ICC-2014 which utilizes ASHRAE 62.2-2013 for its ventilation standard. This modification does not impose a cost to the code.
**2018 International Energy Conservation Code**

Revise as follows:

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<td>The measured air exchange rate.(^a) The mechanical ventilation rate(^b) shall be in addition to the air leakage rate and shall be as proposed.</td>
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Below-grade boundary wall is any thermal boundary wall in soil contact.

Common wall area is the area of walls shared with an adjoining dwelling unit.

\[ L \text{ and } CFA \text{ are in the same units.} \]

<table>
<thead>
<tr>
<th>TABLE R403.6.1 (IRC N1103.6.1)</th>
<th>WHOLE-HOUSE MECHANICAL VENTILATION SYSTEM FAN EFFICACY²</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>FAN LOCATION</strong></td>
<td><strong>SYSTEM TYPE</strong></td>
</tr>
<tr>
<td>HRV, ERV, or balanced</td>
<td>Any</td>
</tr>
<tr>
<td>Range hoods</td>
<td>Any</td>
</tr>
<tr>
<td>In-line supply or exhaust fan</td>
<td>Any</td>
</tr>
<tr>
<td>Other exhaust fan</td>
<td>Bathroom, utility-room</td>
</tr>
<tr>
<td></td>
<td>Bathroom, utility-room</td>
</tr>
</tbody>
</table>

For SI: 1 cfm = 28.3 L/min.

a. When tested in accordance with HVI Standard 916.

Reason: Changes to Table R405.5.2(1):
Ventilation system type is often selected as a function of climate, with supply systems seeing greater specification in the warm climates and exhaust systems seeing greater specification in cold climates. In keeping with ANSI/RESNET 301, this proposed change would compare the performance of the proposed design's ventilation system type with a comparable code-minimum ventilation system type for the reference home. The advantage of this change is that it permits builders and designers to select climate appropriate ventilation systems without receiving an automatic energy penalty that could be associated with the system type. As currently written, a builder selecting a heating or energy recovery ventilator (H/ERV) that meets the code minimum fan efficacy of 1.2 cfm/W would be penalized for not meeting the code minimum exhaust fan efficacy of 2.8-3.5 cfm/W, as determined by Table R403.6.1.

If approved, following are examples of how the reference home would be modeled based on the selection of the proposed design:

1. If the proposed design specifies an H/ERV, the reference home would be modeled with a balanced system without heat or energy recovery and having a fan efficacy of 1.2 cfm/W.
2. If the proposed design specifies a central fan integrated (CFI) system, the reference home would be modeled with an in-line supply fan with an efficacy of 3.8 cfm/W.

3. If the proposed design specifies a bathroom exhaust fan with a flow rate >= 90 cfm, the reference home would be modeled with an exhaust fan with an efficacy of 2.8 cfm/W.

Changes to Table R403.6.1:

Changes proposed to this table are for clarification and simplification. First, the table should not be based on the location of the fan but on the type of fan being installed. For example, an HRV or ERV is not a location, but a system type. Balanced fans without heat recovery are currently omitted from the table, and should be listed along side HRVs and ERVs, which are also balanced systems. Because balanced fans are grouped with HRVs and ERVs, the use of the term "in-line fan" should be clarified to include supply and exhaust in-line systems (also not a location, but a system type). Finally, if a "bathroom" fan is installed in a hallway to provide ventilation (a typical installation location for whole-house mechanical ventilation systems), the current table is silent on the minimum efficacy required, because it does not address “hallway” fans. So, this proposal combines typical bathroom, utility room, and hallway exhaust fans into the category of "other exhaust fans": no changes are made to the fan efficacies for these products. The last column can be deleted by changing the "Air Flow Rate Minimum" column heading to "Air Flow Rate".

**Cost Impact:** The code change proposal will not increase or decrease the cost of construction

Ultimately, ventilation system selection is up to the builder, so there is no increase or decrease in the cost of construction associated with this code change proposal.
**RE179-19**

IECC: TABLE R405.5.2(1) [IRC N1105.5.2(1)]

**Proponent:** Neil Leslie, representing self

# 2018 International Energy Conservation Code

Revise as follows:

**TABLE R405.5.2(1) [IRC N1105.5.2(1)]**

SPECIFICATIONS FOR THE STANDARD REFERENCE AND PROPOSED DESIGNS

Portions of table not shown remain unchanged.

<table>
<thead>
<tr>
<th>BUILDING COMPONENT</th>
<th>STANDARD REFERENCE DESIGN</th>
<th>PROPOSED DESIGN</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heating systems</td>
<td>For other than electric heating without a heat pump: as proposed. Where the proposed design utilizes electric heating without a heat pump, the standard reference design shall be an air source heat pump meeting the requirements of Section C403 of the IECC—Commercial Provisions. Capacity: sized in accordance with Section R403.7.</td>
<td>As proposed</td>
</tr>
<tr>
<td>Cooling systems</td>
<td>As proposed. Air cooled electric air conditioner meeting the requirements of Section C403 of the IECC—Commercial Provisions. Capacity: sized in accordance with Section R403.7.</td>
<td>As proposed</td>
</tr>
<tr>
<td>Service water heating</td>
<td>As proposed. Electric resistance storage water heater meeting the requirements of Section C403 of the IECC—Commercial Provisions. Use: same as proposed design.</td>
<td>As proposed</td>
</tr>
</tbody>
</table>

For SI: 1 square foot = 0.93 m², 1 British thermal unit = 1055 J, 1 pound per square foot = 4.88 kg/m², 1 gallon (US) = 3.785 L, °C = (°F-32)/1.8, 1 degree = 0.79 rad.

- For a proposed design with multiple heating, cooling or water heating systems using different fuel types, the applicable standard reference design system capacities and fuel types shall be weighted in accordance with their respective loads as calculated by accepted engineering practice for each equipment and fuel type present.

- For a proposed design without a proposed heating system, an air source heat pump heating system having the prevailing federal minimum efficiency shall be assumed for both the standard reference design and proposed design.

- For a proposed design without a proposed cooling system, an electric air conditioner having the prevailing federal minimum efficiency shall be assumed for both the standard reference design and the proposed design.

- For a proposed design with a nonstorage-type water heater, a 40-gallon storage-type electric resistance water heater having the prevailing federal minimum energy factor for the same fuel as the predominant heating fuel type shall be assumed. For a proposed design without a proposed water heater, a 40-gallon storage-type water heater having the prevailing federal minimum efficiency for the same fuel as the predominant heating fuel type shall be assumed for both the proposed design and standard reference design.

**Reason:** A single technology-blind baseline performance requirement is critical for a uniform and consistent implementation of the IECC performance path primary intent. Shifting to a single baseline design provides an equitable credit to all technologies that have lower annual costs compared to the single baseline level irrespective of energy form or technology design. It establishes fixed reference home performance requirements BEFORE making the technology and energy choices for the rated home. A single reference design methodology creates a level playing field for all technology and energy forms and provides equitable treatment of advanced renewable, waste heat recovery, hybrid, and multi-fuel technology options. It is especially important for equitable and consistent evaluation of on-site power generation and combined heat and power.
systems.

**Cost Impact:** The code change proposal will not increase or decrease the cost of construction. Options are already available in the current code. This change merely provides a more equitable baseline for performance comparisons.

**Staff Analysis:** Current table note d is deleted and the remaining table notes were relettered.
RE180-19
IECC: R405.3 (IRC N1105.3)

Proponent: Chris McTaggart, Building Efficiency Resources, representing Building Efficiency Resources (cmctaggart@theber.com)

2018 International Energy Conservation Code

Revise as follows:

R405.3 (IRC N1105.3) Performance-based compliance. Compliance based on simulated energy performance requires that a proposed residence (proposed design) be shown to have an annual energy cost that is less than or equal to the annual energy cost of the standard reference design. Energy prices shall be taken from a source approved by the code official such as the Department of Energy, Energy Information Administration's State Energy Data System Prices and Expenditures reports. Code officials shall be permitted to require time-of-use pricing in energy cost calculations.

Exception: The energy use based on source energy expressed in Btu or Btu per square foot of conditioned floor area shall be permitted to be substituted for the energy cost that is less than or equal to the annual source energy use of the standard reference design. The source energy multiplier for electricity shall be 3.16. The source energy multiplier for fuels other than electricity shall be 1.1.

Reason: The current R405 option to demonstrate compliance using comparative annual energy cost between the proposed design and standard reference design introduces an inappropriate additional variable of utility costs that can radically confuse compliance. The ratios between fuel and electricity costs are constantly changing, which can result in a proposed design based on a builder's typical set of architectural plans that achieves compliance on the day that the costs were aggregated, but which does not comply days or months after when costs change. Therefore you can have two homes built from the same planset, with the same specs, built to the same code by the same builder in the same geographic area with one being compliant and the other non-compliant, simply because of variations in the ratios of electric vs fuel costs over time. Similarly, you could have two homes built from the same planset, with the same specs, built to the same code by the same builder at the exact same time in the same geographic area - but in different energy utility territories - with one being compliant and the other non-compliant, simply because they use different utility providers with differing costs.

Furthermore, it is an excessive burden for a code official to have to create and implement their own process for validating the energy utility cost data used in the software file. For one, there is little guidance in the code for code officials for how to define what cost data or process of creating/maintaining cost data is acceptable. The current code suggests that EIA state-average data could be used, which is ok, but should this data be updated monthly? Annually? The EIA state-average data fluctuates month-by-month, and is often seasonal in nature; some software programs allow seasonal inputs, but again - is that what's expected or is it simply an annual average? How often should this cost data be updated? What if a barely-passing planset in a residential development no longer pass the updated energy cost data after the first year of a multi-year build out? If not using EIA data, finding actual data from the specific utilities in question is a huge undertaking, as the fee, rate and tarrif sheets from utilities are typically massive and complex.

There are simply too many questions, variables and outliers associated with cost-based compliance due to the variability and ever changing nature of energy costs. This introduces confusion and a "wildcard" that the code official may not truly understand or understand how to reasonably assess what's fair and reasonable. The "x-factor" of energy costs and the relative difference between fuels and electricity introduce an independent variable that really has to use when assessing building energy efficiency from a compliance standpoint. It is not reasonable to have a variable such as cost be able to change the same planset's compliance within the same code cycle depending on what and when cost data is pulled, and potentially utility vs utility.

This proposal seeks to simplify the Performance compliance process by focusing on known, fixed energy use calculations, resulting in a compliance path that is based exclusively on building energy characteristics and climate data. The proposal maintains the previous "exceptions" of using source energy use or use per sqft of conditioned floor area (otherwise known as a source EUI). While there no doubt has been fair debate over time regarding site vs source energy, electricity vs fuel source energy factors, total energy vs EUI, etc, this proposal does not seek to resolve those conflicts but instead elects to adopt the previous "exception" compliance options already adopted into previous energy codes.

To document the need for this change, I have uploaded two PDF compliance documents produced from REM/Rate software for a planset seeking to comply with the current 2012 IECC with state amendments in Iowa. The proposed design complies with the code by achieving exact cost compliance in dollars as the standard reference design when using 2015 EIA state average cost data, which were the current costs at the time this planset was originally run in the software for compliance. When updating the model to only change costs to the most up-to-date EIA state data (2017), the home now does not comply with the code as the proposed design is estimated to cost more to operate than the standard reference design.

Currently, all software programs that are popularly used to demonstrate compliance (REM/Rate, REM/Design, Ekotrope, EnergyGauge) are set up to create R405 compliance reports exclusively compute cost compliance; they are not set up to express compliance using annual source energy. However, all of these software programs have the ability to configure the Performance compliance reports for either annual source energy or EUI.

Cost Impact: The code change proposal will not increase or decrease the cost of construction
This proposal will have no impact on construction costs. There will be a minor cost to software providers to alter the Performance compliance calculations to annual source energy or source EUI vs cost, but they will unlikely pass these costs down to their users. This proposal will save time and money for code officials and AHJs by reducing the need for the code official to have to police energy cost data in Performance code software.
2018 International Energy Conservation Code

Revise as follows:

R406.2 (IRC N1106.2) Mandatory requirements. Compliance with this section requires that the provisions identified in Sections R401 through R404 indicated as “Mandatory” and Section R403.5.3 be met. The building thermal envelope shall be greater than or equal to levels of efficiency and Solar Heat Gain Coefficients in Table 402.1.1 or 402.1.3 of the 2009 International Energy Conservation Code. The mandatory thermal envelope requirements referenced in this section and Section R406.4 may be met by utilizing the Total UA Alternative referenced in Section R402.1.5.

Exception: Supply and return ducts not completely inside the building thermal envelope shall be insulated to an R-value of not less than R-6.

Add new text as follows:

### Table R406.2 (IRC N1106.2)

<table>
<thead>
<tr>
<th>CLIMATE ZONE</th>
<th>FENESTRATION U-FACTOR</th>
<th>SKYLIGHT U-FACTOR</th>
<th>GLAZED FENESTRATION U-FACTOR</th>
<th>SHGC</th>
<th>CEILING R-VALUE</th>
<th>WOOD FRAME WALL R-VALUE</th>
<th>MASS WALL R-VALUE</th>
<th>FLOOR R-VALUE</th>
<th>BASEMENT WALL R-VALUE</th>
<th>SLAB R-VALUE</th>
<th>CRAWL SPACE WALL R-VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1.20</td>
<td>0.75</td>
<td>0.30</td>
<td></td>
<td>30</td>
<td>15</td>
<td>5.4</td>
<td>13</td>
<td>38</td>
<td>10</td>
<td>0.28</td>
</tr>
<tr>
<td>2</td>
<td>0.80</td>
<td>0.75</td>
<td>0.30</td>
<td></td>
<td>30</td>
<td>15</td>
<td>4.8</td>
<td>13</td>
<td>38</td>
<td>10</td>
<td>10/13</td>
</tr>
<tr>
<td>3</td>
<td>0.80</td>
<td>0.65</td>
<td>0.30</td>
<td></td>
<td>30</td>
<td>15</td>
<td>5.8</td>
<td>19</td>
<td>38</td>
<td>0</td>
<td>0.13</td>
</tr>
<tr>
<td>4 exceed marine</td>
<td>0.35</td>
<td>0.50</td>
<td>NR</td>
<td></td>
<td>38</td>
<td>13</td>
<td>5.10</td>
<td>10</td>
<td>10/13</td>
<td>0</td>
<td>0.28</td>
</tr>
<tr>
<td>5 and 6 marine</td>
<td>0.35</td>
<td>0.50</td>
<td>NR</td>
<td></td>
<td>38</td>
<td>20 or 13+Sh</td>
<td>13/17</td>
<td>30g</td>
<td>10/13</td>
<td>0</td>
<td>10/13</td>
</tr>
<tr>
<td>7 and 8 marine</td>
<td>0.35</td>
<td>0.50</td>
<td>NR</td>
<td></td>
<td>49</td>
<td>20 or 13+Sh</td>
<td>15/19</td>
<td>30g</td>
<td>10/13</td>
<td>10/13</td>
<td>10/13</td>
</tr>
</tbody>
</table>

R-values are minimums, U-factors and SHGC are maximums. R-19 batts compressed into a nominal 2 x 6 framing cavity such that the R-value is reduced by R-1 or more shall be marked w/ the compressed batt R-value in addition to the full thickness R-value.

b. The fenestration U-factor column excludes skylights. The SHGC column applies to all glazed fenestration.
c. "15/19" means R-15 continuous insulated sheathing on the interior or exterior of the home or R-19 cavity insulation at the interior of the basement wall. "15/19" shall be permitted to be met with R-13 cavity insulation on the interior of the basement wall plus R-5 continuous insulated sheathing on the interior or exterior of the home. "10/13" means R-10 continuous insulated sheathing on the interior or exterior of the home or R-13 cavity insulation at the interior of the basement wall.
d. R-5 shall be added to the required slab edge R-values for heated slabs. Insulation depth shall be the depth of the footing or 2 feet, whichever is less in Zones 1 through 3 for heated slabs.
e. There are no SHGC requirements in the Marine Zone.
f. Basement wall insulation is not required in warm-humid locations as defined by Figure R301.1 and Table R301.1.
g. Or insulation sufficient to fill the framing cavity, R-19 minimum.
Reason: The UA Alternative in Section R402.1.5 meets the intent and energy performance of code, using UA value tradeoffs within the envelope to deliver maximum efficiency in delivering envelope performance. The UA Alternative should be available to residential builders regardless of whether the builder is using prescriptive, performance or ERI approach because it encourages innovation and response to individual market/climate factors without minimizing envelope performance. Furthermore, adoption of this approach in the base IECC will encourage adoption of base code, instead of individual jurisdictions lessening prescriptive requirements of R406.4 to achieve the flexibility needed.

Using an approved energy simulation tool, a builder can trade-off elements of the building thermal envelope to achieve superior energy performance, while having the same overall UA value.

A requirement to refer to a previous code cycle for information requires multiple code books with multiple cycles which causes confusion. By adding the information from the table in the 2009 IECC to the 2021 IECC, this allows the use of a single document.

Bibliography: R101.5.1 Compliance materials. The code official shall be permitted to approve specific computer software, worksheets, compliance manuals and other similar materials that meet the intent of this code.

ENERGY SIMULATION TOOL. An approved software program or calculation-based methodology that projects the annual energy use of a building.

Cost Impact: The code change proposal will decrease the cost of construction. This allows builders to adjust envelope features based on climate zone and orientation of a structure. The optimal delivery of envelope efficiencies in that location and orientation could result in savings.
2018 International Energy Conservation Code

Revise as follows:

R406.2 (IRC N1106.2) Mandatory requirements. Compliance with this section requires that the provisions identified in Sections R401 through R404 indicated as “Mandatory” and Section R403.5.3 be met. The building thermal envelope shall be greater than or equal to levels of efficiency and Solar Heat Gain Coefficients in Table 402.1.1 or 402.1.3 of the 2009 International Energy Conservation Code. Where on-site renewable energy is included for compliance using the ERI analysis of Section R406.4, the building thermal envelope shall be greater than or equal to the levels of efficiency and SHGC in Table R402.1.2 or Table R402.1.4 of the 2018 International Energy Conservation Code.

Exception: Supply and return ducts not completely inside the building thermal envelope shall be insulated to an R-value of not less than R-6.

<table>
<thead>
<tr>
<th>CLIMATE ZONE</th>
<th>ENERGY RATING INDEX</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>57</td>
</tr>
<tr>
<td>2</td>
<td>57</td>
</tr>
<tr>
<td>3</td>
<td>57</td>
</tr>
<tr>
<td>4</td>
<td>62</td>
</tr>
<tr>
<td>5</td>
<td>61</td>
</tr>
<tr>
<td>6</td>
<td>61</td>
</tr>
<tr>
<td>7</td>
<td>58</td>
</tr>
<tr>
<td>8</td>
<td>58</td>
</tr>
</tbody>
</table>

Reason: The purpose of this code change proposal is to make two important updates to the Energy Rating Index. First, this proposal makes an editorial improvement by moving footnote “a” of Table R406.4 into Section R406.2, which contains the other mandatory requirements for the ERI. Given that two different thermal envelope backstops apply to the ERI depending on whether on-site renewable energy is included in the calculation, it makes sense to put these two backstops side-by-side in the same section of the code to reduce or eliminate any confusion.

Second, this proposal will update the enhanced thermal envelope backstop for homes with on-site renewable energy from the 2015 to the 2018 IECC, maintaining the same approach as set in the 2018 IECC – specifically, using the prescriptive path from the previous code as a backstop in this situation. This backstop is crucial to use of the ERI with on-site renewable energy. We continue to be concerned about the potential magnitude of trade-off credit that may apply if on-site generation is included in the ERI calculation, analyses have shown that homes can achieve a 20-40 HERS points reduction with average-sized solar PV systems, which would allow enormous trade-offs of the home’s permanent envelope efficiency. See, e.g., RESNET, The Impact of Photovoltaic Arrays on the HERS Index (2015); and https://www.energycodes.gov/sites/default/files/documents/ECodes2016_06_Haack.pdf. Without reasonable limits on these solar trade-offs, homes with on-site generation could be built with far less efficiency, including substandard thermal envelopes, creating long-term problems for homeowners and reversing many of the benefits created by the IECC over the past 10 years.


Cost Impact: The code change proposal will not increase or decrease the cost of construction. The editorial change to move the footnote into Section R406.2 will have no cost impact, and because the 2018 IECC incorporated only very moderate increases in efficiency over the 2015 IECC (primarily in window improvements with no real upgrade cost), we expect no real cost impact. Moreover, this enhanced backstop only applies to homes built to the ERI that incorporate on-site power production into the ERI calculation, which is currently a very small percentage of all code-compliant homes. Code users can also avoid any cost increase by using other compliance paths.
alternatives.
RE183-19
IECC: R406.3 (IRC N1106.3)

Proponent: Ryan Meres, RESNET, representing RESNET (ryan.meres@gmail.com)

2018 International Energy Conservation Code
Revise as follows:

R406.3 (IRC N1106.3) Energy Rating Index. The Energy Rating Index (ERI) shall be determined in accordance with RESNET/ICC 301, except for buildings covered by the International Residential Code, the ERI Reference Design Ventilation rate shall be in accordance with Equation 4-1:

\[
\text{Ventilation rate, CFM} = (0.01 \times \text{total square foot area of house}) + \left[ \frac{7.5 \times \text{(number of bedrooms + 1)}}{\text{area of house}} \right]
\]

(Equation 4-1)

Energy used to recharge or refuel a vehicle used for transportation on roads that are not on the building site shall not be included in the ERI reference design or the rated design.

Reason: The language being proposed for deletion was approved during the 2018 IECC development cycle. Here is the proponent’s reason statement from the proposal:

“As written the ERI ventilation rate specification is in conflict with the ventilation rate specified by the IRC. The current language references ANSI/RESNET/ICC Standard 301 which references the ASHRAE 62.2-2013. The ventilation rate in the ASHRAE Standard 62.2 is significantly higher than the ventilation rate in the IRC. The IRC rate was reaffirmed in Group A changes this code cycle. Without this ventilation rate correction, the higher ventilation rate would use more energy unnecessarily and thereby increase ERI scores for no good reason. Interestingly the ASHRAE 62.2-2010 used the same rate as is in the current IRC.

Third party organizations should not set ventilation rates for the IRC and the IECC. Ventilation rates in the IRC and IECC should be set by the ICC code development process. This proposal brings the IECC/IRC ERI calculation into compliance with the IRC ventilation rate by using the same ventilation equation as will be in Section 1507.3.3 of the 2018 IRC. The published committee reason expected this update, stating: “The difference in ventilation rate might need to be resolved but the experts can solve that through public comments.” This is the public comment they were referring to.”

The proponent makes this statement: “Without this ventilation rate correction, the higher ventilation rate would use more energy unnecessarily and thereby increase ERI scores for no good reason.” In a study conducted by the Florida Solar Energy Center (FSEC), it was found that this change, as included in the 2018 IECC, actually increases ERI scores from 2-10 points, depending on climate zone. The reason for this is that the rated home under Standard 301 is not allowed to use a ventilation rate less than ASHRAE 62.2-2013. Since the 2018 IECC changed the reference home to require less ventilation than the rated home, the home will be shown to use more energy and increase the ERI score.

In a second statement the proponent says: “Third party organizations should not set ventilation rates for the IRC and IECC.” This statement is also false. ANSI/RESNET/ICC Standard 301 does not require any specific ventilation rate, nor does RESNET take a position as to proper ventilation rates. RESNET’s Standard Development Committee 300 chose to reference the most recent ANSI-approved standard for ventilation rates which is ASHRAE 62.2:2013. The standard does not require homes to meet those ventilation rates, instead, the standard simply doesn’t give any “credit” (in the form of lower index scores) for ventilation rates that are less than required by ASHRAE 62.2.

When the proponent of this change in the 2018 cycle, submitted a proposal to change Standard 301, SDC 300 rejected the change with the following reason statement:

“ASHRAE Standard 62.2 is the sole American National Standard on ventilation for indoor air quality in low-rise residential buildings. RESNET has chosen to not conflict with this indoor air quality standard. ANSI/RESNET/ICC Standard 301 does not require any specific level of outdoor air ventilation. However, in order to not encourage outdoor air ventilation levels that do not meet the indoor air quality requirements of ASHRAE Standard 62.2, RESNET has chosen to provide no Energy Rating Index credit for ventilation air flow rates that are less than those required by ASHRAE Standard 62.2. There is no other American National Standard on ventilation for indoor air quality and RESNET has chosen to not provide credits for outdoor air ventilation rates that do not achieve this level of indoor air quality. ANSI/RESNET/ICC Standard 301 does not “require” any level of outdoor air ventilation. Rather it simply stops giving outdoor air exchange energy reduction credit at the 62.2 ventilation specification. The commenter would better seek resolution of the issue raised by this comment by working with the ASHRAE to amend ASHRAE Standard 62.2.”

This change did not achieve the proponent’s stated objectives during the 2018 code development cycle. By NOT approving this change to delete the ventilation requirement for the reference home, the committee would be allowing Section R406 to be out of alignment with Standard 301.

RESNET acknowledges that the scientific and political discussions regarding the “correct” ventilation rate for residential homes is contentious. Neither RESNET nor Standard 301 seek to determine the correct ventilation rate for homes.
At the time ANSI/RESNET/ICC 301-2014 was published, the published American National Standard for Ventilation and Acceptable Indoor Air Quality in Low-Rise Residential Buildings was ASHRAE 62.2-2013. To align with published American National Standards for indoor air quality, RESNET chose to adopt the ventilation rates prescribed by ASHRAE 62.2-2013. RESNET considers this decision to be procedural. RESNET as an organization acknowledges ventilation is important for homes that are built to modern building energy code standards, which require fairly tight envelopes. However, RESNET is neutral regarding the “correct” ventilation rate. To facilitate this neutrality, RESNET Standards do not penalize homes with ventilation rates that are less than ASHRAE 62.2-2013 Standard minimum ventilation rates but RESNET also does not provide energy credit for such homes.

Regardless of which rate may be best, the ERI calculation procedure does not establish requirements for home ventilation rates. Rather such requirements are established by building code authorities and model codes such as set forth in Section R403.6 of the 2018 IECC. The ventilation rates used in the ANSI/RESNET/ICC 301 procedure do not change or modify any requirements of building codes or standards.

**Cost Impact:** The code change proposal will not increase or decrease the cost of construction
This code change proposal does not impact construction practices in any way and, therefore, does not increase the cost of construction. The proposal only impacts how the home is modeled within the energy modeling software, but does not require a home to meet any specific ventilation rate.

Proposal # 4857

RE183-19
2018 International Energy Conservation Code

Revised as follows:

R406.3 (IRC N1106.3) Energy Rating Index. The Energy Rating Index (ERI) shall be determined in accordance with RESNET/ICC 301 except for buildings covered by the International Residential Code, the ERI Reference Design Ventilation rate shall be in accordance with Equation 4-1.

\[
\text{Ventilation rate, CFM} = (0.01 \times \text{total square foot area of house}) + (7.5 \times (\text{number of bedrooms} + 1))
\]

(Equation 4-1)

Energy used to recharge or refuel a vehicle used for transportation on roads that are not on the building site shall not be included in the ERI reference design or the rated design.

For compliance purposes, any reduction in energy use of the rated design associated with on-site renewable energy shall not exceed 5 percent of the total energy use.

Reason: The purpose of this code change proposal is to help ensure that homes are built to an appropriate level of efficiency, irrespective of the amount of on-site generation that may be installed. The proposal adopts a 5 percent cap on the trade-off credit allowed for on-site power in the Energy Rating Index, similar to the 5 percent cap that applies in the simulated performance analysis of the 2018 IECC commercial chapter, Section C407.3, and ASHRAE Standard 90.1-2016 Energy Cost Budget Method.

- **2018 IECC C407.3**: “…The reduction in energy cost of the proposed design associated with on-site renewable energy shall be no more than 5 percent of the total energy cost.”

- **ASHRAE Standard 90.1-2016, Section 11.4.3.1**: “…The reduction in design energy cost associated with on-site renewable energy shall be no more than 5% of the calculated energy cost budget.”

It is important to note that this proposal does not limit the amount of on-site power production that can be installed on the home, nor does it apply any sort of “penalty” to homes with on-site power. The proposal simply recognizes that a reduction in energy use is not the same thing as on-site energy production, for purposes of code compliance. This proposal also supports the long-term goal of achieving net zero energy use by helping avoid steps backward in efficiency as on-site generation increases. If unlimited efficiency trade-off credit is allowed for increases in on-site generation, progress toward net-zero energy will stall. We do not see any good reason to allow steps backward in efficiency when it can be improved simultaneously with increases in on-site power production.

Cost Impact: The code change proposal will increase the cost of construction. The code change proposal will increase the cost of construction only if user selects the ERI compliance path and the cost of increased on-site power production is less than a commensurate amount of energy efficiency. However, given the long expected useful life of a home’s permanent features (such as thermal envelope efficiency), we believe homeowners will experience lower costs and reduced risk over the long-term if trade-off credit for on-site power production is reasonably limited.

Reason:

- The purpose of this code change proposal is to help ensure that homes are built to an appropriate level of efficiency, irrespective of the amount of on-site generation that may be installed. The proposal adopts a 5 percent cap on the trade-off credit allowed for on-site power in the Energy Rating Index, similar to the 5 percent cap that applies in the simulated performance analysis of the 2018 IECC commercial chapter, Section C407.3, and ASHRAE Standard 90.1-2016 Energy Cost Budget Method.

- **2018 IECC C407.3**: “…The reduction in energy cost of the proposed design associated with on-site renewable energy shall be no more than 5 percent of the total energy cost.”

- **ASHRAE Standard 90.1-2016, Section 11.4.3.1**: “…The reduction in design energy cost associated with on-site renewable energy shall be no more than 5% of the calculated energy cost budget.”

It is important to note that this proposal does not limit the amount of on-site power production that can be installed on the home, nor does it apply any sort of “penalty” to homes with on-site power. The proposal simply recognizes that a reduction in energy use is not the same thing as on-site energy production, for purposes of code compliance. This proposal also supports the long-term goal of achieving net zero energy use by helping avoid steps backward in efficiency as on-site generation increases. If unlimited efficiency trade-off credit is allowed for increases in on-site generation, progress toward net-zero energy will stall. We do not see any good reason to allow steps backward in efficiency when it can be improved simultaneously with increases in on-site power production.

Cost Impact: The code change proposal will increase the cost of construction. The code change proposal will increase the cost of construction only if user selects the ERI compliance path and the cost of increased on-site power production is less than a commensurate amount of energy efficiency. However, given the long expected useful life of a home’s permanent features (such as thermal envelope efficiency), we believe homeowners will experience lower costs and reduced risk over the long-term if trade-off credit for on-site power production is reasonably limited.
RE185-19

IECC: R406.4 (IRC N1106.4) (New)

Proponent: Craig Conner, representing self (craig.conner@mac.com)

2018 International Energy Conservation Code

Add new text as follows:

**R406.4 (IRC N1106.4) Energy cost** The ERI as specified by Section 4.1 of RESNET 301 shall be computed with the energy cost as specified by Section R405.3.

**Reason:** The ERI path energy cost calculation should be consistent with the energy cost calculation in the performance path (Section R405). RESNET created their own method, the "normalized Modified End Use Load". The "normalized Modified End Use Load" is a complicated calculation that is inconsistent with the IECC’s performance calculation in R405. The RESNET calculation is shown below in the bibliography. The ERI cost calculation should be consistent with the cost calculation in the IECC’s performance calculation (Section R405).

Bibliography: Here is the normalized Modified End Use Load from RESNET 301
ANSI/RESNET/ICC 301-2019 page 17-18

4.1.1. Calculating End Use Loads. The normalized Modified End Use Loads (nMEUL) for space heating and cooling and service hot water use shall each be determined in accordance with Equation 4.1-1:

\[
n\text{MEUL} = \text{REUL} \times \left( \frac{\text{nEC}_x}{\text{EC}_r} \right) \quad \text{(Eq. 4.1-1)}
\]

where:
\[
\text{nMEUL} = \text{normalized Modified End Use Loads (for heating, cooling, or hot water) as computed using an Approved Software Rating Tool.}
\]
\[
\text{REUL} = \text{Reference Home End Use Loads (for heating, cooling or hot water) as computed using an Approved Software Rating Tool.}
\]
\[
\text{nEC}_x = \text{normalized Energy Consumption for the Rated Home’s end uses (for heating, including Auxiliary Electric Consumption, cooling or hot water) as computed using an Approved Software Rating Tool.}
\]
\[
\text{EC}_r = \text{estimated Energy Consumption for the Reference Home’s end uses (for heating, including Auxiliary Electric Consumption, cooling or hot water) as computed using an Approved Software Rating Tool.}
\]

and where:
\[
\text{nEC}_x = \left( \frac{\text{a} \times \text{EEC}_x - \text{b}}{\text{EC}_x \times \text{EC}_r \times \text{DSE}_r} \right) \times \left( \frac{\text{EEC}_x \times \text{REUL}}{\text{EEC}_x \times \text{REUL}} \right) \quad \text{(Eq. 4.1-1a)}
\]

where:
\[
\text{EEC}_x = \text{Equipment Efficiency Coefficient for the Rated Home’s equipment, such that EEC}_x \text{ equals the energy consumption per unit load in like units as the load, and as derived from the Manufacturer’s Equipment Performance Rating (MEPR) such that EEC}_x \text{ equals 1.0 / MEPR for AFUE, COP or EF ratings, or such that EEC}_x \text{ equals 3.413 / MEPR for HSPF, EER or SEER ratings.}
\]
\[
\text{DSE}_r = \text{REUL/EC}_r \times \text{EEC}_r
\]

For simplified system performance methods, DSE_r equals 0.80 for heating and cooling systems and 1.00 for hot water systems [see Table 4.2.2(1)]. However, for detailed modeling of heating and cooling systems, DSE_r less than 0.80 occurs as a result of part load performance degradation, coil air flow degradation, improper system charge and auxiliary resistance heating for Heat Pumps. Except as otherwise provided by these Standards, where detailed systems modeling is employed, it must be applied equally to both the Reference and the Rated Homes.

\[
\text{EEC}_r = \text{Equipment Efficiency Coefficient for the Reference Home’s equipment, such that EEC}_r \text{ equals the energy consumption per unit load in like units as the load, and as derived from the Manufacturer’s Equipment Performance Rating (MEPR)}
\]
such that $E_{EC, r} = 1.0 / MEPR$ for AFUE, COP or EF ratings, or such that $E_{EC, r} = 3.413 / MEPR$ for HSPF, EER or SEER ratings and where the coefficients ‘a’ and ‘b’ are as defined by Table 4.1.1(1) below:

<table>
<thead>
<tr>
<th>Fuel Type and End Use</th>
<th>a</th>
<th>b</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electric space heating</td>
<td>2.2561</td>
<td>0</td>
</tr>
<tr>
<td>Fossil fuel* space heating</td>
<td>1.0943</td>
<td>0.4030</td>
</tr>
<tr>
<td>Biomass space heating</td>
<td>0.8850</td>
<td>0.4047</td>
</tr>
<tr>
<td>Electric air conditioning</td>
<td>3.8090</td>
<td>0</td>
</tr>
<tr>
<td>Electric water heating</td>
<td>0.9200</td>
<td>0</td>
</tr>
<tr>
<td>Fossil fuel* water heating</td>
<td>1.1877</td>
<td>1.0130</td>
</tr>
</tbody>
</table>

*Such as natural gas, liquid propane gas, fuel oil

4.1.2. Calculating the Energy Rating Index. The Energy Rating Index shall be determined in accordance with Equation 4.1-2:

$$\text{Energy Rating Index} = \text{PEfrac} \ast \frac{(TnML)}{(TRL \ast IAF_{RH})} \ast 100 \quad \text{(Eq. 4.1-2)}$$

where:

- $TnML = nMEU_{HEAT} + nMEU_{COOL} + nMEU_{HW} + EUL_{LA} \text{ (MBtu/y)}.$
- $TRL = REU_{HEAT} + REU_{COOL} + REU_{HW} + REUL_{LA} \text{ (MBtu/y)}.$
- $IAF_{RH} = \text{Index Adjustment Factor of Rated Home, per Eq. 4.3-2}$

and where:

- $EUL_{LA} = \text{The Rated Home end use loads for lighting, appliances and MELs as defined by Section 4.2.2.5.2, converted to MBtu/y, where MBtu/y = (kWh/y)/293 or (Therm’s/y)/10, as appropriate.}$
- $REUL_{LA} = \text{The Reference Home end use loads for lighting, appliances and MELs as defined by Section 4.2.2.5.1, converted to MBtu/y, where MBtu/y = (kWh/y)/293 or (Therm’s/y)/10, as appropriate.}$

and where:

- $\text{PEfrac} = \frac{(TEU - OPP)}{TEU}$
- $TEU = \text{Total energy use of the Rated Home including all rated and non-rated energy features where all fossil fuel site energy uses (Btu_{fossil}) are converted to equivalent electric energy use (kWh_{eq}) in accordance with Equation 4.1-3.}$
- $OPP = \text{On-Site Power Production as defined by Section 4.2.2.6 of this Standard.}$

$$kWh_{eq} = \frac{(Btu_{fossil} * 0.40)}{3412} \quad \text{(Eq. 4.1-3)}$$

Cost Impact: The code change proposal will not increase or decrease the cost of construction. The choice of calculation does not inherently increase or decrease costs. However calculations based on energy cost will better align with the energy costs the consumer sees.

Proposal # 5676

RE185-19
2018 International Energy Conservation Code

Revise as follows:

R406.3 (IRC N1106.3) Energy Rating Index. The Energy Rating Index (ERI) shall be determined in accordance with RESNET/ICC 301 except for buildings covered by the International Residential Code, the ERI Reference Design Ventilation rate shall be in accordance with Equation 4-1.

Ventilation rate, CFM = (0.01 x total square foot area of house) + [7.5 x (number of bedrooms + 1)]

(Exceptions:

1. For Table 4.2.2(1) of RESNET/ICC 301, the Reference Home and Rated Home air exchange rates shall be as specified for the air exchange rates in Table R405.5.2(1) of this code.
2. For Table 4.3.1(1) of RESNET/ICC 301, the air exchange rate shall be as specified for the air exchange rate for the standard reference design in Table R405.5.2(1) of this code.
3. The proposed ventilation rate shall comply with the mechanical ventilation requirements of Section M1505 of the International Residential Code or Section 403.3.2.1 of the International Mechanical Code. Energy used to recharge or refuel a vehicle used for transportation on roads that are not on the building site shall not be included in the ERI reference design or the rated design.

Reason: RESNET/ICC 301 uses the ASHRAE 62.2 ventilation rate not the IRC and IMC ventilation rate. Following the ASHRAE 62.2 ventilation rate results in over ventilation in hot humid climates and cold climates and excessive energy use in all climates. In hot humid climates the resulting part load humidity problems result in mold. In cold climates the high ventilation rates result in excessive dryness. Beyond the problems created by over ventilation, this is also a policy issue. Ventilation rates are set in the I-code development process, not by RESNET. The ERI is being used to show compliance with the l-codes. The IRC and the IMC set building code ventilation rates not RESNET. The ERI should be determined using building code ventilation rates specified by the IRC and the IMC not by RESNET.

RESNET/ICC 301 by following ASHRAE 62.2 also modifies the mechanical ventilation rate required based on infiltration measurements and this results in discouraging better building practices. Tighter houses are penalized compared to leakier houses which makes no sense. If a builder constructs a leakier house then the mechanical ventilation rate is reduced according to RESNET/ICC 301 and ASHRAE 62.2. Infiltration should not be relied on to provide ventilation in new code compliant house construction where enclosures are constructed to 3 ach@50 Pa and 5 ach@50 Pa. Finally, ventilating at a higher, and unnecessary, ventilation rate wastes energy.

If RESNET has an issue with the IRC and the IMC ventilation rates then RESNET should change the ventilation rates using the ICC code change process and not force the use of the ASHRAE 62.2 ventilation rates to judge I-code compliance.

The existing wording has proved confusing. The proposed wording is much clearer. This code change requires that the IRC and IMC ventilation rates be used to determine the ERI.

Cost Impact: The code change proposal will decrease the cost of construction

For those who believe they have to use ASHRAE 62.2 ventilation rates this reduce costs. Even if done "right" over ventilation increases costs due to the costs of dealing with excessive moisture, overly dry air, or moisture damage in some climates.

Proposal # 5587
IECC: R406.3 (IRC N1106.3)

Proponent: Amanda Hickman, The Hickman Group, representing The Leading Builders of America (LBA) (amanda@thehickmangroup.com)

2018 International Energy Conservation Code

Revise as follows:

R406.3 (IRC N1106.3) Energy Rating Index. The Energy Rating Index (ERI) shall be determined in accordance with RESNET/ICC 301 except for buildings covered by the International Residential Code, the ERI Reference Design Ventilation rate shall be in accordance with Equation 4-1.

\[
\text{Ventilation rate, CFM} = (0.01 \times \text{total square foot area of house}) + [7.5 \times (\text{number of bedrooms} + 1)]
\]

(Exception 4-1)

Exceptions:

1. The infiltration and ventilation rate calculated in accordance with ANSI/RESNET/ICC 301 section 4.3.3.2.5 shall be permitted to be less than the rate allowed in ANSI/RESNET/ICC 301, provided the actual whole-house ventilation rate complies with the mechanical ventilation requirements of the International Residential Code Section M1505 or the International Mechanical Code Section 403.3.3.2.1.

2. For the purposes of calculating the ERI of the rated home, the greater of either the minimum allowable Air exchange rate specified by ANSI/RESNET/ICC 301 Table 4.2.2 (1) or the proposed ventilation rate of the Rated Home shall be used for the Air exchange rate in ANSI/RESNET/ICC 301 Table 4.2.2 (1).

Reason: This proposal corrects language that was introduced to this section last cycle that was intended to address the over-ventilation issue that was occurring. However, what was intended to fix this problem, ended up creating another one. Separating the ventilation rates out from the ANSI/RESNET/ICC 301 standard, created two sets of ERI scores (one in ICC and one in RESNET). This is causing huge confusion in the market and with enforcement.

This proposal introduces two exceptions that will simplify and clarify the language while resolving both issues. It corrects the over-ventilation problem while eliminating the double ERI scores. Exception 1 is for the HERS raters, while Exception 2 is for the software programmers.

Cost Impact: The code change proposal will not increase or decrease the cost of construction.

This proposal only clarifies how to apply actual ventilation rate in the proposed design.

Proposal # 5335
IECC: TABLE R406.4 (IRC N1106.4)

Proponent: Craig Conner, representing self (craig.conner@mac.com)

2018 International Energy Conservation Code

Revise as follows:

TABLE R406.4 (IRC N1106.4)
MAXIMUM ENERGY RATING INDEX

<table>
<thead>
<tr>
<th>CLIMATE ZONE</th>
<th>ENERGY RATING INDEX</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
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<td>2</td>
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<td>61</td>
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<td>7</td>
<td>58</td>
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<tr>
<td>8</td>
<td>58</td>
</tr>
</tbody>
</table>

a. Where on-site renewable energy is included for compliance using the ERI analysis of Section R406.4, the building shall meet the mandatory requirements of Section R406.2, and the building thermal envelope shall be greater than or equal to the levels of efficiency and SHGC in Table R402.1.2 or Table R402.1.4 of the 2015 International Energy Conservation Code.

Reason: The ERI is supposed to be flexible. However, this footnote does not allow reduction in even a single component R-value, even if the reduction was more than made up by another energy saving change. Where is the flexibility in the ERI? Every insulation R-value is the same for both the 2015 and 2018 IECC, so none of the R-values can be reduced with the ERI.

Section R402.1.5, "Total UA alternative", allows a UA tradeoff of one component U-factor provided it was made up by another component. Likewise the performance calculation in R405 would allow a component R-value below the R-value in the table, provided the overall building energy use met code. There is no such restriction on tradeoffs in RESNET 301. Why can't the "flexible" ERI in the IECC do the same?

There are multiple other reasons to delete the footnote. It is poor form to put significant requirements in a footnote, even more so for unneeded requirements. Is the SHGC even covered by the footnote? The footnote says to meet SHGC requirements in one of two tables, but Table 402.1.4 does not even have an SHGC requirement. Finally naming another year's IECC makes the code harder to use. Section R406 names both the 2009 and 2015 IECC. Is the code user supposed to keep the 2009, 2015 and the upcoming 2021 IECC in order to use Section 406? The footnote is unnecessary and should be deleted.

Cost Impact: The code change proposal will not increase or decrease the cost of construction
This removes a limitation on flexibility. If anything it will reduce costs.
2018 International Energy Conservation Code

Revise as follows:

R406.3 (IRC N1106.3) Energy Rating Index. The Energy Rating Index (ERI) shall be determined in accordance with RESNET/ICC 301 except for buildings covered by the International Residential Code, the ERI Reference Design Ventilation rate shall be in accordance with Equation 4-1.

\[
\text{Ventilation rate, CFM} = (0.01 \times \text{total square foot area of house}) + [7.5 \times (\text{number of bedrooms + 1})]
\]

(Equation 4-1)

\[\text{Energy used to recharge or refuel a vehicle used for transportation on roads that are not on the building site shall not be included in the ERI reference design or the rated design.}\]

Reason: This language is redundant with other rating requirements and is not necessary. The Energy Rating Index (ERI) is determined in accordance with RESNET/ICC 301 Standard, which does not include vehicle charging/refueling in the end use loads and the Home Energy Rating System (HERS) Index.

Cost Impact: The code change proposal will not increase or decrease the cost of construction. Since the proposed deletion addresses redundancy in requirements, it would neither increase nor decrease construction costs.
**2018 International Energy Conservation Code**

**Revised as follows:**

**R406.4 (IRC N1106.4) ERI-based compliance.** Compliance based on an ERI analysis requires that the rated design including renewable energy systems be shown to have an ERI less than or equal to the appropriate value indicated in Table R406.4 when compared to the ERI reference design.

**TABLE R406.4 (IRC N1106.4)**

<table>
<thead>
<tr>
<th>CLIMATE ZONE</th>
<th>ENERGY RATING INDEX</th>
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<tbody>
<tr>
<td>1</td>
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<td>3</td>
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<td>7</td>
<td>58</td>
</tr>
<tr>
<td>8</td>
<td>58</td>
</tr>
</tbody>
</table>

**Reason:**

The Energy Rating Index is a voluntary path that ensures robust insulation and envelope measures while enabling on-site renewables that enhance the affordability of a home in select climate zones.

In the process of development of the 2018 IECC, in the Public Comment version of RE173-16 the ERI target scores were increased (relaxed) and Footnote a was added to treat projects differently if they do or do not incorporate an on-site renewable energy system. Projects that include a renewable energy system to offset consumption of energy and reduce energy flows at the meter are not rewarded in this revised approach, but are penalized by requiring a higher level of envelope measures. Footnote a requires IECC 2015 envelope backstop for projects with on-site renewable energy systems or 2009 envelope backstop for projects without on-site renewable energy systems. The result is an ERI compliance option that focuses on the building envelope with less-stringent target scores that can be attained without renewable energy systems -- a disincentive for builders to use renewable energy systems in the ERI path.

As presented by the Building Technologies Office of the Department of Energy’s 2018 National Energy Codes Conference, according to the U.S. Energy Information Administration's AEO 2018 report, typical Residential End Uses include Space heating at 24% and Space cooling at 11%, for a combined space heating/cooling at 35% of all Residential Energy End Uses. Water heating accounts for 13.5% of Residential Energy End Uses. These figures illustrate that we have done a very good job of reducing regulated loads, such that unregulated loads (such as lighting loads, appliance loads, and plug loads) now represent greater than 50% of all Residential Energy End Uses. Renewable energy systems can offset not only the unregulated loads, but can also offset the reduced regulated loads.

Compliance measures and compliance paths that focus only on building envelope measures and discourag or penalize renewable energy systems - or fail to make renewable energy systems attractive to builders as a compliance option -- are focused on solving 35% of the problem. The IECC should encourage the use of energy efficiency plus renewable energy, to solve 100% of the problem. In fact, new homes with PV systems and EV chargers can also power our consumer vehicles with sunlight, solving greater than 100% of the building energy problem.

This proposal restores the lower, more stringent ERI target values of the 2015 IECC and again makes renewable energy systems an attractive option for builders.

Effective integration of energy efficiency measures and renewable energy systems is critical to the future of energy codes and green/stretch/reach codes. At the time of submittal of these code change proposals, there are four states with 100% renewable energy goals: Hawaii, California, New Jersey, and New York. Other communities are committing to renewable energy goals through their own local renewable goals for power supply or...
for installation of renewable energy systems. Distributed Generation (DG) is an important component of these overall portfolio standards.

**Bibliography:** U.S. Energy Information Administration Annual Energy Outlook 2018
https://www.eia.gov/outlooks/aeo/index.php

**Cost Impact:** The code change proposal will not increase or decrease the cost of construction
This proposal encourages the installation of renewable energy systems, which provides more flexibility to the builder and could result in either increased or decreased first cost of construction, depending on builder choices.

Proposal # 5582

RE190-19
Proponent: Lauren Urbanek, representing Natural Resources Defense Council (lurbanek@nrdc.org)

2018 International Energy Conservation Code
Revise as follows:

TABLE R406.4 (IRC N1106.4)
MAXIMUM ENERGY RATING INDEX

<table>
<thead>
<tr>
<th>CLIMATE ZONE</th>
<th>ENERGY RATING INDEX</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>≤2.56</td>
</tr>
<tr>
<td>2</td>
<td>57</td>
</tr>
<tr>
<td>3</td>
<td>57</td>
</tr>
<tr>
<td>4</td>
<td>≤2.56</td>
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<tr>
<td>5</td>
<td>≤4.54</td>
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<tr>
<td>6</td>
<td>≤4.55</td>
</tr>
<tr>
<td>7</td>
<td>≤4.55</td>
</tr>
<tr>
<td>8</td>
<td>≤4.55</td>
</tr>
</tbody>
</table>

a. Where on-site renewable energy is included for compliance using the ERI analysis of Section R406.4, the building shall meet the mandatory requirements of Section R406.2, and the building thermal envelope shall be greater than or equal to the levels of efficiency and SHGC in Table R402.1.2 or Table R402.1.4 of the 2015 International Energy Conservation Code.

Reason: The purpose of this proposal is to increase the efficiency of homes built to the Energy Rating Index, to reflect average HERS scores already being achieved in each climate zone. Data from RESNET shows that in 2017, the average HERS score being achieved in each climate zone is, in many cases, already lower than the requirements in the 2018 IECC. Homes are already being built to the proposed values in each of the climate zones, so the numbers proposed are inherently realistic. Therefore, it is appropriate to adjust the ERI scores to better reflect reality.

Furthermore, as building component technology and the efficiency of systems and equipment continues to improve, it is important to continue to promote ever-increasing levels of efficiency in the IECC. When the ERI targets were first set during the 2015 code cycle, the RESNET HERS system, could not calculate energy savings from certain hot water energy efficiency measures. The RESNET HERS system has since been modified to account for energy savings from certain hot water efficiency measures. These savings are based on simple and inexpensive measures such as lower-flow plumbing fittings and hot water layouts that minimize water waste.

The subsequent increase in HERS scores in the 2018 IECC made this path of the code less stringent – and in fact, builders in most climate zones already exceed the 2018 requirements. The values in this proposal are more stringent than the 2018 IECC, yet still not as stringent as the 2015 requirements.

By strengthening the ERI scores in Table R406.4, the IECC will drive further innovation, better building practices, and more energy cost savings for homeowners.


Cost Impact: The code change proposal will increase the cost of construction. This code change proposal requires more efficiency in the ERI path of the code, which means that the cost of construction may increase for builders following this path of code as compared to if they were meeting the minimum requirements of the 2018 ERI path. However, the ERI scores in this proposal are based off of the average values reported to RESNET in 2017 for homes being built in each climate zone. That means that builders are already building to these values – regardless of what values are in the code – and so the cost of construction will not go up in many cases. Furthermore, this proposal only affects the ERI compliance path, which is only one compliance option and will not increase the cost of construction available to the builder under other compliance options.
RE192-19
IECC: TABLE R406.4 (IRC N1106.4)

Proponent: William Fay, Energy-Efficient Codes Coalition, representing Energy-Efficient Codes Coalition (bfay@ase.org); Daniel Bresette, Alliance to Save Energy, representing Alliance to Save Energy (dbresette@ase.org); Maureen Guttman, BCAP-IBTS, representing BCAP-IBTS (mguttman@bcapcodes.org); Harry Misuriello, American Council for an Energy-Efficient Economy, representing American Council for an Energy-Efficient Economy (misuriello@verizon.net)

2018 International Energy Conservation Code
Revise as follows:

TABLE R406.4 (IRC N1106.4)
MAXIMUM ENERGY RATING INDEX

<table>
<thead>
<tr>
<th>CLIMATE ZONE</th>
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</thead>
<tbody>
<tr>
<td>1</td>
<td>57 52</td>
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<td>2</td>
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<td>3</td>
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<td>6</td>
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<td>7</td>
<td>58 53</td>
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<td>8</td>
<td>58 53</td>
</tr>
</tbody>
</table>

a. Where on-site renewable energy is included for compliance using the ERI analysis of Section R406.4, the building shall meet the mandatory requirements of Section R406.2, and the building thermal envelope shall be greater than or equal to the levels of efficiency and SHGC in Table R402.1.2 or Table R402.1.4 of the 2015 International Energy Conservation Code.

Reason: The purpose of this code change proposal is to establish lower, more efficient ERI target scores, improving efficiency for homes complying under the Energy Rating Index. More precisely, the proposal restores the lower ERI Index target scores from the 2015 IECC. Under the ERI, the lower the score, the more efficient the home. Although the ERI numbers were increased to the current levels as part of a broad compromise in the 2018 IECC, we believe that over time the ERI must continue to be improved, and improving the Index numbers by returning to the 2015 IECC levels at some point is a reasonable first step in the right direction.

Although a direct comparison between the ERI and other IECC compliance options is complicated, the ERI numbers proposed (and those in the 2015 IECC) are within the range of equivalence to other compliance paths under the IECC. U.S. DOE published an analysis that compared compliance under the IECC with HERS scores, using over 60,000 model runs to test the range of HERS scores that could apply to a 2012 IECC-compliant home. The study found that the 2015 ERI scores would be more likely to ensure compliance with the IECC, but even those scores could not guarantee compliance. “Thus, one can conclude that the [2015 IECC] ERIs are generally very near the conservative end of possible values, but not quite so low as to always guarantee that a home complying via the ERI path would also comply via the Performance Path.” See U.S. Department of Energy, Identification of RESNET HERS Index Values Corresponding to Minimal Compliance with the IECC Performance Path, at 4.17 (May 2014). Given that the other compliance options in the IECC have moderately improved since the 2012 IECC, we believe that these more stringent ERI scores would be appropriate as an upgrade to the current less efficient ERI levels for 2021.


Cost Impact: The code change proposal will increase the cost of construction
To achieve a lower ERI score, builders must install more efficient products or systems in homes, which will increase construction costs. Because the ERI is a performance-based path, the costs and benefits to the consumer will vary depending on which improvements are incorporated into the home design. However, since the ERI is not mandatory and is one of only several compliance options, builders are not required to use this option if they do not find it acceptable for a specific project.
**Proposed Code Change: R406.2 (IRC N1106.2) Mandatory requirements**

Compliance with this section requires that the provisions identified in Sections R401 through R404 indicated as “Mandatory” and Section R403.5.3 be met. The building thermal envelope shall be greater than or equal to levels of efficiency and Solar Heat Gain Coefficients in Table 402.1.1 or 402.1.3 of the 2009 2012 International Energy Conservation Code.

**Exception:** Supply and return ducts not completely inside the building thermal envelope shall be insulated to an R-value of not less than R-6.

**Reason:**

The purpose of this code change proposal is to help ensure that homes built to the Energy Rating Index (ERI) incorporate a reasonably efficient thermal envelope by updating the minimum thermal envelope backstop from the prescriptive level in the 2009 IECC to the 2012 edition of the IECC. We view this improvement as part of a broader effort to gradually improve the efficiency of the IECC and to reduce the likelihood that homes will be built with below-average levels of efficiency in the thermal envelope. A robust thermal envelope is crucial to long-term energy conservation. The ERI gives builders an unprecedented amount of flexibility in achieving code compliance. Unlike other compliance methods, using the ERI compliance path, builders may take credit for efficiency improvements in HVAC equipment, appliances, and lighting. To help reduce the risk of a home being built with an exceptionally weak permanent thermal envelope, Section R406.2 currently requires an ERI-rated home to meet or exceed the prescriptive thermal envelope requirements of the 2009 IECC. We believe this requirement is very easily achieved by the vast majority of homebuilders (some of whom are building beyond the code’s base requirements), but it is an important consumer protection all the same. State and local policymakers agree—to our knowledge, in every state in which the ERI has been adopted as part of a 2015 or 2018 IECC update, the 2009 thermal envelope backstop has also been adopted.

The ERI thermal envelope backstop is now due for an update. By the time the 2021 IECC is finalized, the 2009 IECC will be 12 years old (and given the typical lag of state code adoption, the lag could be even longer).

The modification proposed above strikes a balance between efficiency and flexibility, while updating one of the IECC’s most important built-in backstops. The building’s permanent thermal envelope will outlast many of the shorter-term improvements (such as HVAC equipment, lighting, and appliances).

**Bibliography:**


**Cost Impact:**

The code change proposal will increase the cost of construction. However, the prescriptive requirements (including those for the thermal envelope) of the 2012 IECC have been found cost-effective by US DOE. See U.S. Department of Energy, National Energy and Cost Savings for New Single- and Multifamily Homes: A Comparison of the 2006, 2009, and 2012 editions of the IECC (April 2012) available at https://www.energycodes.gov/sites/default/files/documents/NationalResidentialCostEffectiveness.pdf. We believe that those who currently use the ERI will be able to comply with 2012 IECC thermal envelope requirements with little or no additional effort. However, for those builders that would have traded away more of the thermal envelope efficiency, the proposal above will apply a reasonable limit to these trade-offs.
RE194-19
IECC: R202 (IRC N1101.6), TABLE R406.4 (IRC N1106.4)

Proponent: Steven Rosenstock, Edison Electric Institute, representing Edison Electric Institute (srosenstock@eei.org)

2018 International Energy Conservation Code
Revise as follows:

TABLE R406.4 (IRC N1106.4)
MAXIMUM ENERGY RATING INDEX

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<th>CLIMATE ZONE</th>
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a. Where on-site renewable energy is included for compliance using the ERI analysis of Section R406.4, the building shall meet the mandatory requirements of Section R406.2, and the building thermal envelope shall be greater than or equal to the levels of efficiency and SHGC in Table R402.1.2 or Table R402.1.4 of the 2015 International Energy Conservation Code.

b. In a state, region, or country that has a renewable portfolio standard of 50% or greater, on-site renewable electric energy production systems shall receive credit only where they are installed with an on-site energy storage system that has a rated capacity of at least 3.5 kWh.

SECTION R202 (IRC N1101.6)
GENERAL DEFINITIONS

Add new definition as follows:

RENEWABLE PORTFOLIO STANDARD (RPS). A policy that requires electricity producers within a given jurisdiction to supply a certain minimum amount, capacity, or percentage of their electricity from designated renewable resources.

Reason: More states / areas of the United States are increasing their Renewable Portfolio Standards. As more distributed renewable electric energy systems are installed, there are situations where there is too much supply and too little demand, especially in the fall, winter, and spring. In California, this has been called the “duck curve”. In Hawaii, this has been called the “Nessie curve”. In these cases, the grids are dealing with the issue of oversupply. In 2018, the California ISO had to curtail over 461,000 MWh (461 Million kWh) of solar and wind electric generation.

Energy storage, both grid-side and customer-side, will be needed to help address this situation. With energy storage, there is much less likelihood (or even no chance) that renewable electricity will be curtailed or not used.

In the newest version of Title 24, builders are allowed to adjust the size of residential PV systems if they also installed energy storage systems in combination with the PV.

This proposal is forward looking and will help both homeowners and the grid in the future, especially in areas with aggressive Renewable Portfolio Standards.

The definition is needed for support of the new language in the proposal. This is an “umbrella” definition that encompasses all of the variations of RPS policies throughout the United States (and world). RPS policies vary on a state by state basis, as there is no federal standard in the United States. However, in other countries that use the IECC, there may be country-wide policies that would be in effect.

More details about RPS policies can be found on numerous web sites, including the following:
Cost Impact: The code change proposal will increase the cost of construction. Based on current battery technology and costs, the estimated cost impact will be approximately $1750 (3.5 kWh * $500/kWh installed) for homes that are located in areas with high RPS requirements and that install on-site renewable electric energy generation systems.
2018 International Energy Conservation Code
Revise as follows:

**TABLE R406.4 (IRC N1106.4)**

**MAXIMUM ENERGY RATING INDEX**

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\(^a\) Where on-site renewable energy is included for compliance using the ERI analysis of Section R406.4, the building shall meet the mandatory requirements of Section R406.2, and the building thermal envelope shall be greater than or equal to the levels of efficiency and SHGC in Table R402.1.2 or Table R402.1.4 of the 2015 International Energy Conservation Code.

b. Where the installation of an on-site renewable energy system is a mandatory requirement in the code, the building shall receive credit only for the capacity installed that is above the minimum mandatory requirement.

**Reason:** In California, the latest version of Title 24 will go into effect on 1/1/2020. In the energy code, there is a requirement for new homes to install on-site PV systems, based on the following formula:

\[
kW_{PV} = \frac{(CFA \times A)}{1000} + (NDwell \times B)
\]

- \(kW_{PV}\) = kWdc size of the PV system
- \(CFA\) = Conditioned floor area
- \(NDwell\) = Number of dwelling units
- \(A\) = Adjustment factor from Table 150.1-C (range of 0.572 to 1.56)
- \(B\) = Dwelling adjustment factor from Table 150.1-C (range of 1.06 to 1.51)

There are exceptions to the requirement, but most homes will be required to install systems that range in size from 2 to 5 kW.

Under the ERI compliance path, homes with such systems get credits (lower scores). However, if such systems are already required by the code, should they receive full credit?

With other efficiency programs, once the federal or state baseline is increased (e.g., 10 to 13 SEER, for example), the incentives for the 13 SEER system disappear, since it is no longer a "high efficiency" option, but a required minimum standard.

This proposal follows that precedent. Systems that meet the mandated minimum requirements should not receive credit, since they are not going "above and beyond" what is required. Only systems that exceed the minimum requirements should get credit for the incremental energy production they are providing.

**Bibliography:**
- California Energy Commission, "2019 Standards Part 6 Chapter 8 (Section 150.1) Revised Express Terms" TN-223257-3

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

Where the PV system is sized larger than the required minimum, the extra cost will be on the order of $2,700 per kW (DC) of incremental peak rated capacity. The value is based on the November 2018 NREL report on US solar installations at residential facilities.
For example, if the minimum requirement is 3 kW (DC), and a 5 kW (DC) system is installed, the extra cost will be approximately $5,400.
RE196-19
IECC: TABLE R406.4 (IRC N1106.4)

Proponent: Joel Martell, representing National Association of Home Builders (jmartell@nahb.org)

2018 International Energy Conservation Code
Revise as follows:

TABLE R406.4 (IRC N1106.4)
MAXIMUM ENERGY RATING INDEX

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<th>CLIMATE ZONE</th>
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a. Where on-site renewable energy is included for compliance using the ERI analysis of Section R406.4, the building shall meet the mandatory requirements of Section R406.2, and the building thermal envelope shall be greater than or equal to within 15% of the levels of efficiency and SHGC in Table R402.1.2 or Table R402.1.4 of the 2015 International Energy Conservation Code.

Reason: This modification gives on-site renewable energy a 15% credit of the current edition of the code when using the Energy Rating Index. It clears up confusion about calling reference to past editions of the IECC and enables the code user to use one edition of the code instead of referencing a past edition. As the code is written right now there is no credit for installing onsite renewable energy while mandating rigorous prescriptive requirement of the 2015 IECC with no room for flexibility. The prescriptive tables have been virtually untouched in the 2018 edition and could potentially go unchanged for cycles to come. The ERI path is intended to allow for flexibility while constructing an energy efficient home. The proposal gives a reasonable amount of flexibility without jeopardizing the integrity or efficiency of the homes. The 15% allowance will prevent from installing single pane windows and prevent significant reductions in building thermal envelope components.

Cost Impact: The code change proposal will not increase or decrease the cost of construction
This proposal does not change the cost of construction it increases the flexibility.

Proposal # 4323

RE196-19
2018 International Energy Conservation Code

Revise as follows:

R406.5 (IRC N1106.5) Verification by approved agency. Verification of compliance with Section R406 shall be completed by an approved third party, working under the auspices of an approved rating provider as defined in ANSI/RESNET/ICC 301.

Reason: In the 2018 IECC, Standard 301 is only referenced for the calculation of the ERI. However, there are many other aspects of Standard 301 that address implementation items, like: inspection of minimum rated features, certified raters, approved rating providers and labeling. Without any reference to some of these items in the code, there are no requirements other than an “approved” third party to verify compliance. Unfortunately, that provides little guidance to the local code official. In addition, there is currently no quality assurance requirements under the ERI path. Homes complying with the ERI path will only be subject to quality assurance if they are using the HERS index and submit a “Confirmed” rating to RESNET. After having the ERI path in the code for two cycles now, it has become clear that there is confusion about the nuances of its implementation in the field. This change will help to clarify any confusion about who should be approved as a third party to verify compliance with the ERI path.

Cost Impact: The code change proposal will not increase or decrease the cost of construction
The Home Energy Rating System (HERS) Index is the most common option for ERI compliance. All RESNET Certified HERS Raters are required to work under the auspices of a Quality Assurance Provider. Therefore, this proposal is simply recognizing an industry practice that already exists and will not lead to any increase to the cost of construction.
RE198-19
IECC: R406.5 (IRC N1106.5), ISO Chapter 6 (IRC Chapter 44)

Proponent: Aaron Gary, representing Self (aaron.gary@texenergy.org)

2018 International Energy Conservation Code

Revise as follows:

R406.5 (IRC N1106.5) Verification by approved agency. Verification of compliance with Section R406 shall be completed by an approved third party that has been accredited to ISO/IEC 17065.

Reason: The ERI path has been a welcome addition of the IECC. The DOE Home Energy Rating Variability Study [https://www.energycodes.gov/sites/default/files/documents/NECC2018_11_Williams.pdf] showed unacceptably high levels of variance in ERI ratings however, which begs the question of if ERI is an acceptable and defendable means of consistently demonstrating CODE Compliance. I think the answer is that it CAN be oversight of the ERI is strengthened beyond what currently exists. Using an consensus body developed Standard, in the same vein as RESNET/ICC 380, NFRC 400 and HVI Standard 916, is a reasonable means of accomplishing this. Specifically using the ANSI-developed Standard (ISO/IEC 17065) that the EPA is already moving to include in to its ENERGY STAR for Homes program for the verifying the ERI of dwellings in the program is only logical choice.

Cost Impact: The code change proposal will not increase or decrease the cost of construction
The code change proposal will not increase or decrease the cost of construction but it will increase the quality of service and results expected of 3rd-party verifiers.
IECC: R406.5 (IRC N1106.5)

Proponent: Robby Schwarz, EnergyLogic, representing EnergyLogic (robby@nrglogic.com)

2018 International Energy Conservation Code

Revise as follows:

R406.5 (IRC N1106.5) Verification by approved agency. Verification of compliance with the Section R406 as outlined in Section R406.4 and R406.6 shall be completed by an approved third party. Verification of Section R406.2 shall be completed by the authority having jurisdiction or an approved third party inspection agency per Section R105.4.

Reason: R406.5 Verification by an approved agency. Currently, this section is causing confusion between jurisdictions and approved third parties. Many jurisdictions believe that the third party is verifying all aspects of the energy code while many approved third parties believe they should only generate the ERI score. This is leading to homes that are not getting fully code verified because fundamentally the development of an ERI score solely, and ERI Rating, is different from a full code compliance rating.

The HERS Index benchmarks the efficiency of a home in comparison to a reference home that is based on the 2006 IECC. A HERS Rating is an asset rating of the energy features in a home. This means that in the process of a HERS Rating to generate the HERS Index a Rater does not necessarily inspect to see if energy features governed by the code are installed according to requirements of the code. For example, the HERS Ratings systems’ insulation installation grading criteria gives guidance on how to de-rate the R-value of poorly installed insulation. The Rater is required to give a grade 3 to poor installations. The HERS Index score is intended to evaluate the performance of what is installed. It is not intended to determine if it was installed per the requirement of code. A code rating or evaluation for the generation of the ERI score, on the other hand, should only use a grade 1 because only grade 1 installation of insulation meets the requirements of manufacturer instructions and therefore code. If a Rater were to evaluate a home for an ERI score and come across grade 3 installation of insulation, the installation should fail the inspection and be re-installed to meet code requirements.

In this way, an ERI rating and a HERS rating are fundamentally different. One is held to a pass/fail requirement of code and the other is a quantification and evaluation of energy assets or components of the home. This small example demonstrates how the HERS index score and the ERI score differ.

The language that is added to this section clearly defines that the generation of the ERI score is in the approved third parties’ scope of work and that the remainder of the code compliance verification be performed by the third party or not, depending on the agreement between the jurisdiction and the third party.

Cost Impact: The code change proposal will not increase or decrease the cost of construction

This code change proposal does not increase the cost of construction or the utilization of this pathway in the code. It merely defines how to use the path to ensure compliance with the code.
RE200-19
IECC: R406.5.1 (IRC N1106.5.1) (New)

Proponent: Ryan Meres, representing RESNET (ryan.meres@gmail.com)

2018 International Energy Conservation Code
Add new text as follows:

R406.5.1 (IRC N1106.5.1) Quality Assurance Approved third party verifiers and all residential buildings demonstrating compliance with Section R406 shall comply with the quality assurance requirements in accordance with ANSI/RESNET/ICC 301.

Reason: There has been confusion about the differences between ERI and HERS, especially when it comes to quality assurance requirements. Currently, under the 2018 IECC, a permit applicant could submit an ERI Compliance Report to demonstrate compliance with the energy code without any requirement subjecting that rating to quality assurance. The only way a home complying with the ERI path will be subject to quality assurance is if that home uses a HERS rating and a "confirmed" rating is submitted to RESNET. Sections 5.1.4.1.3 and 5.1.4.2.3 of ANSI/RESNET/ICC 301 require that “Confirmed” and “Sampled” ratings be subject to Quality Assurance requirements “equivalent to Section 900 of the Mortgage Industry National Home Energy Rating Systems Standard.”

One of the most important benefits of the ERI compliance path is the requirement for third party verification of compliance. Many local code officials are under the misconception that all homes using the ERI for compliance are subject to quality assurance. Unfortunately, this is not true.

This proposal would require that the approved third party verifiers are working under a program that has quality assurance requirements; and the homes they're responsible for verifying are subject to those quality assurance standards.

Cost Impact: The code change proposal will not increase or decrease the cost of construction
The Home Energy Rating System (HERS) Index is the most common option for ERI compliance. All RESNET Certified HERS Raters are required to work under the auspices of a Quality Assurance Provider. Therefore, this proposal is simply recognizing an industry practice that already exists and will not lead to any increase to the cost of construction.

Proposal # 4911
2018 International Energy Conservation Code

Add new text as follows:

R406.5.2 (IRC N1106.5.2) Compliance documentation for certificate of occupancy. Third parties that have been approved to verify compliance with R406 shall provide the following documentation to the code official, prior to issuance of a certificate of occupancy:

1. Documentation that the approved third party is certified by an approved rating provider in accordance with ANSI/RESNET/ICC 301;
2. Documentation demonstrating that the mandatory requirements in R406.2 have been met;
3. A compliance report in accordance with R406.6.2 that is clearly indicated as a “Confirmed Rating” or “Sampled Rating” as defined by ANSI/RESNET/ICC 301;
4. Documentation of air leakage testing results in accordance with R402.4.1.2;
5. Documentation of duct leakage testing results in accordance with R403.3.3.

Reason: Despite education efforts, there is confusion among code officials and third party verifiers about the documentation that should be required, prior to the issuance of a certificate of occupancy, for compliance with the ERI path. Since this is still a relatively new compliance path for the IECC, the proponents of this proposal feel that it is necessary to provide guidance to local code officials and third party verifiers. This proposal seeks to add each of the proposed documentation items for the following reasons:

1. This provision ensures that third party verifiers are subject to quality assurance procedures
2. This item ensures that third party verifiers are verifying the mandatory requirements of the IECC and not just what’s required to conduct the rating
3. ANSI/RESNET/ICC 301 only requires “Confirmed” and “Sampled” ratings to be subject to quality assurance, so this item ensures that third parties are not submitting a “projected” rating to the code officials that is not subject to quality assurance
4. Documenting the envelope air leakage results ensures that those numbers are in alignment with the figures used in obtaining the ERI score
5. Documenting the duct leakage results ensures that those numbers are in alignment with the figures used in obtaining the ERI score.

Overall, this proposal will improve consistency among third parties and code officials in documenting compliance with the ERI path.

Cost Impact: The code change proposal will not increase or decrease the cost of construction. This proposal does not add any construction requirements to the code. It simply requires that some basic documentation be submitted to demonstrate compliance with R406.
2018 International Energy Conservation Code

Revise as follows:

R406.6.2 (IRC N1106.6.2) **Compliance report.** Compliance software tools shall generate a report that documents that the ERI of the *rated design* complies with Sections R406.3 and R406.4. The compliance documentation shall include the following information:

1. Address or other identification of the residential building.
2. Declare Energy Rating Index on title page.
3. An inspection checklist documenting the building component characteristics of the *rated design*. The inspection checklist shall show results for both the *ERI reference design* and the *rated design*, and shall document all inputs entered by the user necessary to reproduce the results.
4. Name of individual completing the compliance report.
5. Name and version of the compliance software tool.

**Exception:** Where an otherwise identical building model is offered in multiple orientations, compliance for any orientation shall be permitted by documenting that the building meets the performance requirements in each of the four (north, east, south and west) cardinal orientations.

**Reason:** This code change is being proposed to clarify the energy path to the code official and the documentation for permit. Many reports do not specify the path that is being proposed and the code official has to contact the applicant to verify the energy path they are intending to use, to comply with the energy code. By providing the method of compliance the code official can focus on the details of the report and this information will expedite the permit process time.

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

This will increase the cost of construction by a minor amount, adding a data entry to the report.
**RE203-19**

IECC: R406.6.2 (IRC N1106.6.2)

**Proponent:** William Fay, Energy-Efficient Codes Coalition, representing Energy-Efficient Codes Coalition (bfay@ase.org); Daniel Bresette, Alliance to Save Energy, representing Alliance to Save Energy (dbresette@ase.org); Maureen Guttman, BCAP-IBTS, representing BCAP-IBTS (mguttman@bcapcodes.org); Harry Misuriello, American Council for an Energy-Efficient Economy, representing American Council for an Energy-Efficient Economy (misuriello@verizon.net)

2018 International Energy Conservation Code

Revise as follows:

R406.6.2 (IRC N1106.6.2) Compliance report. Compliance software tools shall generate a report that documents that the ERI of the rated design complies with Sections R406.3 and R406.2 through R406.4. The compliance documentation shall include the following information:

1. Address or other identification of the residential building.
2. An inspection checklist documenting the building component characteristics of the rated design. The inspection checklist shall show results for both the ERI reference design and the rated design, and shall document all inputs entered by the user necessary to reproduce the results. The checklist shall document compliance with each requirement under Section R406.2
3. Name of individual completing the compliance report.
4. Name and version of the compliance software tool.

**Exception:** Where an otherwise identical building model is offered in multiple orientations, compliance for any orientation shall be permitted by documenting that the building meets the performance requirements in each of the four (north, east, south and west) cardinal orientations.

**Reason:** The purpose of this proposal is to correct what we believe to be an omission in the Energy Rating Index compliance report and to provide additional clarity and direction to software makers about how to incorporate the mandatory backstop provisions of the ERI into compliance software. The compliance report outlined in Section R406.6.2 does not currently require software to document whether the project complies with the mandatory provisions of Section R406.2. The proposal above corrects this by adding Section R406.2 to the list of sections to be included in the compliance report and adds the requirements of Section R406.2 to the inspection checklist. Although mandatory provisions and backstops have been a part of the IECC for many years, software designed for voluntary or “above-code” programs (such as HERS rating software) may not directly address mandatory items or treat them with the appropriate level of importance. Code officials understand very well that when a provision is listed as “mandatory,” the building simply cannot achieve compliance without meeting that provision. Now that more and more code users are turning to software and rating professionals for code compliance, it is important to provide additional details for software developers as to how to incorporate these important provisions.

**Cost Impact:** The code change proposal will not increase or decrease the cost of construction

No code requirements are changed by this proposal, but the addition of the mandatory requirements to the compliance report and checklist will help ensure quality construction and facilitate code compliance.

Proposal # 4011
RE204-19
IECC: R202 (IRC N1101.6), R406.6.3 (IRC N1106.6.3) (New)

Proponent: jim edelson, representing New Buildings Institute (jim@newbuildings.org)

2018 International Energy Conservation Code

SECTION R202 (IRC N1101.6)
GENERAL DEFINITIONS

Add new definition as follows:

RENEWABLE ENERGY CERTIFICATE (REC). An instrument that represents the environmental attributes of one megawatt hour of renewable energy; also known as an energy attribute certificate (EAC).

Add new text as follows:

R406.6.3 (IRC N1106.6.3) Renewable energy certificates (RECs) documentation. Where onsite renewable energy is included in the calculation of an ERI, one of the following forms of documentation shall be provided to the code official:

1. Substantiation that the RECs associated with the onsite renewable energy are owned by, or retired on behalf of, the homeowner.
2. A contract that conveys to the homeowner the RECs associated with the onsite renewable energy, or conveys to the homeowner an equivalent quantity of RECs associated with other renewable energy.

Reason: This proposal impacts who may claim the environmental attributes of an onsite-renewable energy system. The environmental attributes of solar power, or other renewable energy, have market value that is reflected and transacted in RECs.

When the installer, leasing company or financial agent in the solar panel transaction strips that value from the homeowner by taking possession of the RECs, according to the Federal Trade Commission the power produced by the solar panels on the house would have an "unqualified claim" as renewable energy. To prevent this, the proposal ensures that environmental attributes are not double counted towards compliance with the IECC.

While this proposal does not cite Green-E, the Green-E Standard describes the double counting that occurs when RECs have been transferred to another party in the renewable transaction:

Examples of prohibited double uses include, but are not limited to:

1) When the same REC is sold by one party to more than one party, or any case where another party has a conflicting contract for the RECs or the renewable electricity;

2) When the same REC is claimed by more than one party, including any expressed or implied environmental claims made pursuant to electricity coming from a renewable energy resource, environmental labeling or disclosure requirements. This includes representing the energy from which RECs are derived as renewable in calculating another entity’s product or portfolio resource mix for the purposes of marketing or disclosure;

3) When the same REC is used by an electricity provider or utility to meet an environmental mandate, such as an RPS, and is also used to satisfy customer sales under Green-e Energy; or

4) Use of one or more attributes of the renewable energy or REC by another party. This includes when a REC is simultaneously sold to represent "renewable electricity" to one party, and one or more Attributes associated with the same MWh of generation (such as CO2 reduction) are also sold, to another party.

To prevent the situation where double counting is credited within the ERI calculation, thereby artificially reducing ERI scores and allowing the homeowner to install fewer energy efficiency features than otherwise would be required, this proposal ensures that the homeowner retains possession of the RECs associated with onsite renewable energy systems. In the case where those RECs for the onsite system cannot be transferred to the homeowner, an equivalent quantity of RECs must be provided.

Bibliography: Federal Register, Volume 77, Number 197; October 11, 2012; 16 CFR Part 260; "Guides for the Use of Environmental Marketing Plans".


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

This proposal impacts who may claim the environmental attributes of an onsite-renewable energy system. The environmental attributes of the solar power have market value, reflected in RECs. The cost of installing solar panels may be reduced when the installer, leasing company or financial agent strips that value from the homeowner by taking possession of the RECs.

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

Proposal # 5047
IECC: R406.6.2 (IRC N1106.6.2), R406.6.2.1 (IRC N1106.6.2.1) (New), R406.6.2.2 (IRC N1106.6.2.2) (New)

Proponent: Robby Schwarz, EnergyLogic, representing EnergyLogic (robby@nrglogic.com)

2018 International Energy Conservation Code

Revise as follows:

R406.4 (IRC N1106.4) ERI-based compliance. Compliance based on an ERI analysis requires that the rated proposed design and confirmed built dwelling be shown to have an ERI less than or equal to the appropriate value indicated in Table R406.4 when compared to the ERI reference design.

R406.6.2 (IRC N1106.6.2) Compliance report. Compliance software tools shall generate a report that documents that the home and the ERI score of the rated design complies with Sections R406.2, R406.3 and Section R406.4. The compliance documentation shall be created for the proposed design and shall be submitted with the application for the building permit. Confirmed compliance documents of the built dwelling unit shall be created and submitted to the code official for review before a certificate of occupancy is issued. Compliance reports shall include information in accordance with Sections R406.6.2.1 and R406.6.2.2 include the following information:

1. Address or other identification of the residential building.
2. An inspection checklist documenting the building component characteristics of the rated design. The inspection checklist shall show results for both the ERI reference design and the rated design, and shall document all inputs entered by the user necessary to reproduce the results.
3. Name of individual completing the compliance report.
4. Name and version of the compliance software tool.

Exception: Where an otherwise identical building model is offered in multiple orientations, compliance for any orientation shall be permitted by documenting that the building meets the performance requirements in each of the four (north, east, south and west) cardinal orientations.

Add new text as follows:

R406.6.2.1 (IRC N1106.6.2.1) Proposed compliance report for permit application. Compliance reports submitted with the application for a building permit shall include the following:

1. Building street address, or other building site identification.
2. The name of the individual performing the analysis and generating the compliance report.
3. The name and version of the compliance software tool.
4. If requested by the authority having jurisdiction, documentation of all inputs entered into the software used to produce the results for the reference design and/or the rated home.
5. A certificate indicating that the proposed design has an ERI less than or equal to the appropriate score indicated in Table R406.4 when compared to the ERI reference design. The certificate shall document the building component energy specifications that are included in the calculation including, component level insulation $R$-values or $U$-factors, assumed duct system and building envelope air leakage testing results, as well as the type and rated efficiencies of proposed heating, cooling, mechanical ventilation, and service water heating equipment to be installed. If onsite renewable energy systems will be installed the certificate shall report the type and production size of the proposed system.
6. When a site-specific report is not generated, the proposed design shall be based on the worst-case orientation and configuration of the rated home.

R406.6.2.2 (IRC N1106.6.2.2) Confirmed compliance report for a certificate of occupancy. A confirmed compliance report submitted for obtaining the certificate of occupancy shall be made site and address specific and include the following:

1. Building street address or other building site identification.
2. The name of the individual performing the analysis and generating the report.
3. The name and version of the compliance software tool.
4. If requested by the authority having jurisdiction, documentation of all inputs entered into the software used to produce the results for the reference design and/or the rated home.
5. A final confirmed certificate indicating that the confirmed rated design of the built home complies with Sections R406.2 and R406.4. The certificate shall report the energy features that were confirmed to be in the home including component level insulation $R$-values or $U$-factors, results from any required duct system and building envelope air leakage testing, as well as, the type and rated efficiencies of the heating, cooling, mechanical ventilation, and service water heating equipment installed. When onsite renewable energy systems have been installed on or in the home the certificate shall report the type and production size of the installed system.

Reason: The word Rating defines a process by which one can systematically and repeatably assess and inspect a home. One can perform a code rating, an energy rating, a program or EnergyStar rating, and so on. In this way the process of evaluation may differ in that an Energy Rating is an asset rating while a Code Rating is a compliance rating. So, although the evaluation can be different Ratings ensure that verification of installed features is the same.
Section R405 Simulated Performance Alternative and Section R406 Energy Rating Index Compliance Alternative both use a rating process for verifying compliance of the home, so the bulk of this code change proposal adds language to this section that is the same as used in Section R405 to explain what is needed to demonstrate compliance for obtaining the building permit (proposed design) and what is needed in order to release the certificate of occupancy (confirmed Reports).

Cost Impact: The code change proposal will not increase or decrease the cost of construction
This code change proposal does not increase the cost of construction or the utilization of this pathway in the code. It merely defines how to use the path to ensure compliance with the code.

Proposal # 5260

RE205-19
IECC: R401.2 (IRC N1101.13), R401.2.1 (IRC N1101.13.1) (New), R407 (IRC N1107) (New), R407.1 (IRC N1107.1) (New), R407.2 (IRC N1107.2) (New), TABLE R407.2 (IRC N1107.2) (New)

Proponent: William Fay, Energy-Efficient Codes Coalition, representing Energy-Efficient Codes Coalition (bfay@ase.org); Maureen Guttman, BCAP-IBTS, representing BCAP-IBTS (mguttman@bcapcodes.org)

2018 International Energy Conservation Code

Revise as follows:

R401.2 (IRC N1101.13) Compliance. Projects shall comply with Section R401.2.1 and one of the following:

1. Sections R401 through R404.
2. Section R405 and the provisions of Sections R401 through R404 indicated as “Mandatory.”
3. The energy rating index (ERI) approach in Section R406.

Add new text as follows:

R401.2.1 (IRC N1101.13.1) Additional Energy Efficiency (Mandatory). This section establishes additional requirements applicable to all compliance approaches to achieve additional energy efficiency.

1. For buildings complying under Sections R401 through R404, one or more additional energy efficiency measures shall be installed in accordance with Section R407.2 that cumulatively equal or exceed 5 Flex Points.
2. For buildings complying under the simulated performance alternative in Section R405, the building shall meet one of the following:
   2.1. One or more additional energy efficiency measures in Section R407.2 shall be installed that cumulatively equal or exceed five Flex Points, without including such measures in the proposed design under Section R405; or
   2.2. The proposed design of the building under Section R405.3 shall have an annual energy cost that is less than or equal to 95 percent of the annual energy cost of the standard reference design.
   2.3. For buildings that comply under the energy rating index alternative in Section R406, the energy rating index value shall be at least 5 percent less than the energy rating index target specified in Table R406.4.

R407 (IRC N1107)

FLEX POINTS FOR ADDITIONAL ENERGY EFFICIENCY

R407.1 (IRC N1107.1) Scope. This section establishes flex point alternatives to achieve additional energy efficiency in accordance with Section R401.2.

R407.2 (IRC N1107.2) Flex Points for additional energy efficiency. Measures shall be selected from Table R407.2. Each measure chosen shall receive credit for the Flex Points as indicated in the Table for the specific Climate Zone. Interpolation of points between measures shall not be permitted.

<table>
<thead>
<tr>
<th>Measure Number</th>
<th>Measure Description</th>
<th>Climate Zone 1</th>
<th>Climate Zone 2</th>
<th>Climate Zone 3</th>
<th>Climate Zone 4</th>
<th>Climate Zone 4C</th>
<th>Climate Zone 5</th>
<th>Climate Zone 6</th>
<th>Climate Zone 7</th>
<th>Climate Zone 8</th>
</tr>
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<tbody>
<tr>
<td>1a</td>
<td>≥ 2.5% reduction in total UA</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>1b</td>
<td>≥ 5% reduction in total UA</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>5</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>1c</td>
<td>≥ 7.5% reduction in total UA</td>
<td>5</td>
<td>5</td>
<td>5</td>
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<td>6</td>
<td>7</td>
<td>8</td>
<td>8</td>
<td></td>
</tr>
<tr>
<td>2a</td>
<td>≥ 10% reduction in glazed vertical fenestration area-weighted average SHGC</td>
<td>2</td>
<td>1</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
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</tr>
<tr>
<td>2b</td>
<td>≥ 20% reduction in glazed vertical fenestration area-weighted average SHGC</td>
<td>4</td>
<td>1</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>3a</td>
<td>≤ 3 ACH50 air leakage rate with ERV or HRV installed</td>
<td>2</td>
<td>4</td>
<td>5</td>
<td>7</td>
<td>7</td>
<td>7</td>
<td>8</td>
<td>8</td>
<td></td>
</tr>
<tr>
<td>3b</td>
<td>≤ 2 ACH50 air leakage rate with ERV or HRV installed</td>
<td>2</td>
<td>5</td>
<td>7</td>
<td>9</td>
<td>9</td>
<td>10</td>
<td>11</td>
<td>11</td>
<td></td>
</tr>
</tbody>
</table>
4a. Climate Zone 4C is Climate Zone Marine 4.

b. The Total UA shall be calculated in accordance with Section R402.1.5 Total UA alternative.

c. Minimum Heat Recovery Ventilator (HRV) and Energy Recovery Ventilator (ERV) requirements, measured at the lowest tested net supply airflow, shall be ≥ 75% Sensible Recovery Efficiency (SRE); ≤ 1.1 W/CFM Fan Energy and shall not use recirculation as a defrost strategy. In addition, the Energy Recovery Ventilator (ERV) shall be ≥ 50% Latent Recovery/Moisture Transfer (LRMT).

d. As defined by Section R403.3.7.

e. For multiple cooling systems, all systems shall meet or exceed the minimum efficiency requirements in Table R407.2 and shall be sized to serve 100% of the cooling design load. As an alternative, each system installed shall receive credit for the percentage of the Flex Points for the measure equal to the percentage of the cooling design load served by the system.

f. For multiple heating systems, all systems shall meet or exceed the minimum efficiency requirements in Table R407.2 and shall be sized to serve 100% of the heating design load. As an alternative, each system installed shall receive credit for the percentage of the Flex Points for the measure equal to the percentage of the heating design load served by the system.

Reason: The purpose of this code change proposal is to improve overall residential building efficiency (heating, cooling and water heating energy) by roughly 5% and to create a scalable, flexible means of improving residential building efficiency for future IECC updates. Instead of requiring efficiency improvements to specific building components, the new “Flex Points” approach in Section R407 provides a multitude of options for builders to achieve the efficiency requirements of the IECC. This approach is also scalable according to a jurisdiction’s needs – states or localities who need additional energy savings to meet energy or climate policy goals can adjust the number of required points accordingly. Package- or points-based approaches have been used for several years in Washington and Oregon. And since the 2012 IECC, the commercial provisions have included section C406 Additional Efficiency Package Options. We believe the updated approach in this proposal is a sensible means of achieving additional efficiency now and in the future.

This proposal is similar to the Flex Points proposal for the 2018 IECC in overall structure, but the points table has been simplified and updated based on feedback received in the previous Code Development Cycle. Like the previous version, this proposal also includes alternative compliance pathways for builders who select the simulated performance alternative or the Energy Rating Index, and will bring roughly equivalent improvements to all three compliance paths.

This Flex Points proposal is cost-effective, since it includes a number of options to achieve 5 points that are cost-effective.

The Flex Points proposal will provide three distinct benefits for jurisdictions adopting the 2021 IECC:

1. This proposal meets a clear need for efficiency improvements in the model energy code now and in the future.

Although the IECC has made small efficiency gains in the 2015 and 2018 editions, major gains have plateaued. Buildings still consume an estimated 42% of the nation’s energy, 54% of its natural gas, and 71% of its electricity. Governors, legislators, and mayors are increasingly turning to building energy codes to meet energy and climate goals, and those codes should continue to provide reasonable improvements going forward. The U.S. Conference of Mayors, in its fourth consecutive resolution on the subject, reiterated their “concerted support for putting future triennial IECC updates on a “glide path” of steady efficiency gains that will improve the efficiency performance of millions of U.S. residential, multi-family, and commercial
Several jurisdictions have already created or are in the process of creating package-based compliance paths or improved code provisions to meet their policy needs. The result is improved efficiency, but a lack of consistency in both format and requirements. Incorporating Flex Points into the 2021 IECC will not only provide a 5% boost in energy conservation but will also provide a realistic map for additional improvements going forward. And by providing more uniform targets for the efficiency of building components, this proposal will contribute to economies of scale, potentially lowering prices for builders and ultimately consumers.

2. **This proposal will provide maximum flexibility for builders to achieve improved efficiency.**

Flex Points trusts that builders and design professionals will select the most cost-effective and sensible efficiency improvements for a given project. There are several alternatives for compliance in each climate zone, along with options to comply in a performance- or rating-based path. There are alternatives related to more insulation, more efficient windows, reduced air and duct leakage and improved equipment. We believe that this approach provides the right incentives for builders to make long-lasting improvements in residential buildings that are in the best interests of homeowners.

The point values have been calculated based on the present value of energy cost savings over the current code (including relevant federal equipment efficiency standards) and reflect the estimated useful life of each measure over an assumed 30-year life of the building. While a 30-year period is consistent with the typical life of a mortgage, it is a very conservative period given the likelihood that some measures will provide efficiency benefits for decades beyond the initial 30-year period.

The analysis behind the flex points is based on the methodology and assumptions included in the U.S. Department of Energy’s Methodology for Evaluating Cost-Effectiveness of Residential Energy Code Changes, including the economic equations to obtain the present value of energy costs within the calculation methodology. The energy consumption calculations take into consideration heating, cooling, and water heating energy, using DOE-2 energy simulation across 105 TMY3 weather locations and 12 building types to account for varying stories, foundations, and fuel types for each of the baseline and upgrade measures. The analysis compares the annual energy savings between a home with and without an efficiency measure over the useful life of the efficiency measure using useful life data from NAHB and other sources. Energy costs were calculated using the most recent national EIA projections for natural gas and electricity. Because the analysis uses readily-available and widely-accepted tools and methodologies, we expect that future additions or changes will be straightforward.

3. **This proposal will encourage efficiency improvements in building components that are currently difficult to regulate.**

Flex Points addresses two issues that have complicated model energy codes for many years. First, innovative building practices or emerging technologies can benefit from being listed in codes, but states (and national code developing organizations) are reluctant to require new technologies or practices before they are market-tested. As a result, there are high barriers to entry for new technologies, even when they could transform the marketplace and provide energy- or cost-saving benefits for homeowners. As an example, Heat Recovery Ventilators (HRVs) are cost-effective and reasonable for much of the country, but individual circumstances or climate conditions may favor another approach. Rather than require HRVs in every case, or most cases with exceptions, HRVs and Energy Recovery Ventilators are included as one of several options available to builders in every climate zone. Not only will Flex Points create an opportunity for good technology to be used in more buildings, but it will open the door for market forces to make these technologies more widely available (and presumably less expensive to consumers). As new technologies or practices become available, these advances can be quickly and easily added into the Flex Points table, fast-tracking technology that is good for consumers.

Second, much of the heating, cooling, and water heating equipment installed in residential buildings is subject to federal preemption under the National Appliance Energy Conservation Act. As has been debated at length in ICC Code Development hearings over the last 15 years, including equipment efficiencies in performance trade-offs tends to weaken the efficiency of the energy code, since federal minimum efficiencies for nearly every covered product is well below the efficiency levels of commonly installed products. When these efficiency levels are used in trade-off baselines, builders use the improved efficiency of common heating, cooling, and water heating products as a means of trading away efficiency of more permanent building components and features, even though the equipment would have been installed anyway. This “free ridership” may provide short-term cost savings for homebuilders, but it saddles homeowners with unexpected high energy costs over the entire useful life of the building. Moreover, this equipment often carries a much shorter useful life, which is not typically captured in code compliance simulations.

Flex Points creates a new incentive to improve the efficiency of covered products without resulting in efficiency rollbacks elsewhere in the code. Heating, cooling, and water heating improvements (among others) are included among the Flex Points options with points calculated according to climate-specific energy cost savings and the longevity of the equipment. As compared to the previous Flex Points proposal, the list of options has been simplified and refocused on the equipment most likely to provide meaningful energy savings. Each of these upgrades will build upon the current IECC efficiency, rather than trading it away.

In sum, we believe that this proposal will improve efficiency by roughly 5% while unlocking the competitive market for new technologies or building components that are difficult to regulate and will provide a useful new tool for policymakers across the country – all without rolling back the effectiveness or efficiency of the IECC.

Cost Impact: The code change proposal will increase the cost of construction. Requiring additional efficiency measures, such as more insulation, more efficient windows, reduced air leakage and duct leakage, and/or more efficient equipment, to save 5% energy will increase the cost of construction, but the resulting energy and cost savings will recoup the initial costs and will continue to benefit consumers over the useful life of the home.

Proponent: Eric Makela, New Buildings Institute, representing Northwest Energy Codes Group (ericM@newbuildings.org)

2018 International Energy Conservation Code

Revise as follows:

R401.2 (IRC N1101.13) Compliance. Projects shall comply with Section R401.2.1 one of the following:

1. Sections R401 through R404.
2. Section R405 and the provisions of Sections R401 through R404 indicated as “Mandatory.”
3. The energy rating index (ERI) approach in Section R406.

Add new text as follows:

R401.2.1 (IRC N1101.13.1) Additional Energy Efficiency (Mandatory) This section establishes additional requirements applicable to all compliance approaches to achieve additional energy efficiency.

1. For buildings complying under Sections R401 through R404, one or more additional energy efficiency measure(s) shall be installed in accordance with Section R407.2 that cumulatively equal or exceed 10 (ten) Flex Points.
2. For buildings complying under the simulated performance alternative in Section R405, the building shall meet one of the following: (a) one or more additional energy efficiency measure(s) in Section R407.2 shall be installed that cumulatively equal or exceed ten Flex Points, without including such measures in the proposed design under Section R405; or (b) the proposed design of the building under section R405.2 shall have an annual energy cost that is less than or equal to 90% of the annual energy cost of the standard reference design.
3. For buildings that comply under the energy rating index alternative in Section R406, the energy rating index value shall be at least 10% less than the energy rating index target specified in Table R406.4.

SECTION R407 (IRC N1107)
FLEX POINTS FOR ADDITIONAL ENERGY EFFICIENCY

R407.1 (IRC N1107.1) Scope. This section establishes flex point alternatives to achieve additional energy efficiency in accordance with Section R401.2.1.

R407.2 (IRC N1107.2) Flex points for additional energy efficiency Measures shall be selected from Table R407.2.1. Each measure chosen shall receive credit for the Flex Points as indicated in the Table for the specific Climate Zone. Interpolation of points between measures shall not be permitted.

TABLE R407.2 (IRC N1107.2)
FLEX POINTS FOR ADDITIONAL ENERGY EFFICIENCY

<table>
<thead>
<tr>
<th>Measure Number</th>
<th>Measure Description</th>
<th>CZ 1</th>
<th>CZ 2</th>
<th>CZ 3</th>
<th>CZ 4C</th>
<th>CZ 5</th>
<th>CZ 6</th>
<th>CZ 7</th>
<th>CZ 8</th>
</tr>
</thead>
<tbody>
<tr>
<td>1a</td>
<td>≥ 2.5% reduction in total UA</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>1b</td>
<td>≥ 5% reduction in total UA</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>4</td>
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<td>5</td>
<td>5</td>
</tr>
<tr>
<td>1c</td>
<td>≥ 7.5% reduction in total UA</td>
<td>5</td>
<td>5</td>
<td>5</td>
<td>5</td>
<td>6</td>
<td>7</td>
<td>8</td>
<td>8</td>
</tr>
<tr>
<td>2a</td>
<td>≥ 10% reduction in glazed vertical fenestration area-weighted average SHGC</td>
<td>2</td>
<td>1</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>2b</td>
<td>≥ 20% reduction in glazed vertical fenestration area-weighted average SHGC</td>
<td>4</td>
<td>1</td>
<td>-</td>
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<td>-</td>
<td>-</td>
<td>-</td>
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<tr>
<td>3a</td>
<td>≤ 3 ACH50 air leakage rate with ERV or HRV installed</td>
<td>2</td>
<td>4</td>
<td>5</td>
<td>7</td>
<td>7</td>
<td>7</td>
<td>8</td>
<td>8</td>
</tr>
<tr>
<td>3b</td>
<td>≤ 2 ACH50 air leakage rate with ERV or HRV installed</td>
<td>2</td>
<td>5</td>
<td>7</td>
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<td>----</td>
</tr>
<tr>
<td>4c</td>
<td>100% of ductless thermal distribution system or hydronic thermal distribution system located completely inside the building thermal envelope or 100% of duct thermal distribution system located in conditioned space</td>
<td>8</td>
<td>8</td>
<td>9</td>
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<td>12</td>
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<td>17</td>
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<td>≥ 18 SEER and ≥ 14 EER cooling system efficiency</td>
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<td>7</td>
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<td>≥ 16 EER cooling system efficiency</td>
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<td>≥ 96 AFUE heating system efficiency</td>
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<td>≥ 0.8 EF for fossil fuel service water heating system</td>
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<td>5</td>
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<tr>
<td>8c</td>
<td>≥ 0.4 Solar Fraction for service water heating system</td>
<td>8</td>
<td>9</td>
<td>9</td>
<td>7</td>
<td>9</td>
<td>6</td>
<td>5</td>
<td>4</td>
</tr>
</tbody>
</table>

a. Climate Zone 4C is Climate Zone Marine 4.

b. The Total UA shall be calculated in accordance with Section R402.1.5 Total UA alternative.

c. Minimum Heat Recovery Ventilator (HRV) and Energy Recovery Ventilator (ERV) requirements, measured at the lowest tested net supply airflow, shall be ≥ 75% Sensible Recovery Efficiency (SRE), ≤ 1.1 W/CFM Fan Energy and shall not use recirculation as a defrost strategy. In addition, the Energy Recovery Ventilator (ERV) shall be ≥ 50% Latent Recovery/Moisture Transfer (LRMT).

d. As defined by Section R403.3.7.

e. For multiple cooling systems, all systems shall meet or exceed the minimum efficiency requirements in Table R407.2.1 and shall be sized to serve 100% of the cooling design load. As an alternative, each system installed shall receive credit for the percentage of the Flex Points for the measure equal to the percentage of the cooling design load served by the system.

f. For multiple heating systems, all systems shall meet or exceed the minimum efficiency requirements in Table R407.2.1 and shall be sized to serve 100% of the heating design load. As an alternative, each system installed shall receive credit for the percentage of the Flex Points for the measure equal to the percentage of the heating design load served by the system.

**Reason:** This proposal, submitted by the Northwest Energy Codes Group, provides an alternative to the Flex Point proposal submitted by the Energy Efficient Codes Coalition by requiring ten flex points for an efficiency increase of ten (10) percent over the base prescriptive codes. The Northwest pioneered the use of the prescriptive residential options that are currently in place in Washington, and formally were used in Oregon, and found them to be an effective method of increasing efficiency for residential construction using the prescriptive approach. This option does not require performance energy modeling or HERS verification which will increase it usefulness. This type of points based option can also be easily implemented in the U.S. DOE REScheck software. This approach is also similar in structure to the Points Option code change proposal that has been submitted by the Northwest Energy Codes Group to C407 in the commercial provisions of the 2018 IECC. This proposal will provide more consistency between the IECC and the Washington State Residential Energy Code which is based on the IECC.

The purpose of this code change proposal is to improve overall residential building efficiency (heating, cooling and water heating energy) by roughly 10% and to create a scalable, flexible means of improving residential building efficiency for future IECC updates. Instead of requiring efficiency improvements to specific building components, the new “Flex Points” approach in Section R407 provides a multitude of options for builders to achieve the efficiency requirements of the IECC. This approach is also scalable according to a jurisdiction’s needs – states or localities who need additional energy savings to meet energy or climate policy goals can adjust the number of required points accordingly. Package- or points-based approaches have been used for several years in Washington and Oregon.

This proposal is similar to the Flex Points proposal for the 2018 IECC in overall structure, but the points table has been simplified and updated based on feedback received in the previous Code Development Cycle. Like the previous version, this proposal also includes alternative compliance pathways for builders who select the simulated performance alternative or the Energy Rating Index, and will bring roughly equivalent improvements to all three compliance paths.

This Flex Points proposal is cost-effective, since it includes a number of options to achieve 10 points that are cost-effective.

The Flex Points proposal will provide three distinct benefits for jurisdictions adopting the 2021 IECC:

1. This proposal meets a clear need for efficiency improvements in the model energy code now and in the future.

Although the IECC has made small efficiency gains in the 2015 and 2018 editions, major gains have plateaued. Buildings still consume an estimated
42% of the nation’s energy, 54% of its natural gas, and 71% of its electricity. Governors, legislators, and mayors are increasingly turning to building energy codes to meet energy and climate goals, and those codes should continue to provide reasonable improvements going forward. The U.S. Conference of Mayors, in its fourth consecutive resolution on the subject, reiterated their “concerted support for putting future triennial IECC updates on a “glide path” of steady efficiency gains that will improve the efficiency performance of millions of U.S. residential, multi-family, and commercial buildings.” See 2018 U.S.C.M. Resolution 86 (June 11, 2018).

Several jurisdictions have already created or are in the process of creating package-based compliance paths or improved code provisions to meet their policy needs. The result is improved efficiency, but a lack of consistency in both format and requirements. Incorporating Flex Points into the 2021 IECC will not only provide a 10% boost in energy conservation but will also provide a realistic map for additional improvements going forward. And, by providing more uniform targets for the efficiency of building components, this proposal will contribute to economies of scale, potentially lowering prices for builders and ultimately consumers.

2. This proposal will provide maximum flexibility for builders to achieve improved efficiency.

Flex Points trusts that builders and design professionals will select the most cost-effective and sensible efficiency improvements for a given project. There are several alternatives for compliance in each climate zone, along with options to comply in a performance- or rating-based path. There are alternatives related to more insulation, more efficient windows, reduced air and duct leakage and improved equipment. We believe that this approach provides the right incentives for builders to make long-lasting improvements in residential buildings that are in the best interests of homeowners.

The point values have been calculated based on the present value of energy cost savings over the current code (including relevant federal equipment efficiency standards) and reflect the estimated useful life of each measure over an assumed 30-year life of the building. While a 30-year period is consistent with the typical life of a mortgage, it is a very conservative period given the likelihood that some measures will provide efficiency benefits for decades beyond the initial 30-year period.

The analysis behind the flex points is based on the methodology and assumptions included in the U.S. Department of Energy’s Methodology for Evaluating Cost-Effectiveness of Residential Energy Code Changes, including the economic equations to obtain the present value of energy costs within the calculation methodology. The energy consumption calculations take into consideration heating, cooling, and water heating energy, using DOE-2 energy simulation across 105 TMY3 weather locations and 12 building types to account for varying stories, foundations, and fuel types for each of the baseline and upgrade measures. The analysis compares the annual energy savings between a home with and without an efficiency measure over the useful life of the efficiency measure using useful life data from NAHB and other sources. Energy costs were calculated using the most recent national EIA projections for natural gas and electricity. Because the analysis uses readily-available and widely-accepted tools and methodologies, we expect that future additions or changes will be straightforward.

3. This proposal will encourage efficiency improvements in building components that are currently difficult to regulate.

Flex Points addresses two issues that have complicated model energy codes for many years. First, innovative building practices or emerging technologies can benefit from being listed in codes, but states (and national code developing organizations) are reluctant to require new technologies or practices before they are market-tested. As a result, there are high barriers to entry for new technologies, even when they could transform the marketplace and provide energy- or cost-saving benefits for homeowners. As an example, Heat Recovery Ventilators (HRVs) are cost-effective and reasonable for much of the country, but individual circumstances or climate conditions may favor another approach. Rather than require HRVs in every case, or most cases with exceptions, HRVs and Energy Recovery Ventilators are included as one of several options available to builders in every climate zone. Not only will Flex Points create an opportunity for good technology to be used in more buildings, but it will open the door for market forces to make these technologies more widely available (and presumably less expensive to consumers). As new technologies or practices become available, these advances can be quickly and easily added into the Flex Points table, fast-tracking technology that is good for consumers.

Second, much of the heating, cooling, and water heating equipment installed in residential buildings is subject to federal preemption under the National Appliance Energy Conservation Act. As has been debated at length in ICC Code Development hearings over the last 15 years, including equipment efficiencies in performance trade-offs tends to weaken the efficiency of the energy code, since federal minimum efficiencies for nearly every covered product is well below the efficiency levels of commonly installed products. When these efficiency levels are used in trade-off baselines, builders use the improved efficiency of common heating, cooling, and water heating products as a means of trading away efficiency of more permanent building components and features, even though the equipment would have been installed anyway. This “free ridership” may provide short-term cost savings for homebuilders, but it saddles homeowners with unexpected high energy costs over the entire useful life of the building. Moreover, this equipment often carries a much shorter useful life, which is not typically captured in code compliance simulations.

Flex Points creates a new incentive to improve the efficiency of covered products without resulting in efficiency rollbacks elsewhere in the code. Heating, cooling, and water heating improvements (among others) are included among the Flex Points options with points calculated according to climate-specific energy cost savings and the longevity of the equipment. As compared to the previous Flex Points proposal, the list of options has been simplified and refocused on the equipment most likely to provide meaningful energy savings. Each of these upgrades will build upon the current IECC efficiency, rather than trading it away.

In sum, we believe that this proposal will improve efficiency by roughly 10% while unlocking the competitive market for new technologies or building
components that are difficult to regulate and will provide a useful new tool for policymakers across the country – all without rolling back the effectiveness or efficiency of the IECC.

**Bibliography:** *Uniting Cities to Accelerate Focus on the Economic and Climate Benefits of Boosting America's Building Energy Efficiency*, 2019


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

The code change proposal will increase the cost of construction. Requiring additional efficiency measures, such as more insulation, more efficient windows, reduced air leakage and duct leakage, and/or more efficient equipment, to save 10% energy will increase the cost of construction, but the resulting energy and cost savings will recoup the initial costs and will continue to benefit consumers over the useful life of the home.
2018 International Energy Conservation Code

Revise as follows:

R401.2 (IRC N1101.13) Compliance. Projects shall comply with one of the following:

1. Sections R401 through R404 and Section R407.
2. Section R405, Section R407 and the provisions of Sections R401 through R404 indicated as “Mandatory.”
3. The energy rating index (ERI) approach in Section R406.

Add new text as follows:

**R407 (IRC N1107) ADDITIONAL ENERGY EFFICIENCY REQUIREMENTS**

**R407.1 (IRC N1107.1) Scope.** This section establishes options for additional criteria to be met for one- and two-family dwellings and townhouses, as defined in Section 101.2 of the *International Residential Code* to demonstrate compliance with this code.

**Exception:** These requirements shall not apply to:

1. Homes complying under the Energy Rating Index (R406)
2. Alternations, renovations and repairs to an existing building
3. Additions with a conditioned floor area of less than 1,200 square feet

**R407.2 (IRC N1107.2) Requirements.** In order to comply with this code:

1. Building utilizing the prescriptive path to comply with this code shall also comply with sufficient energy efficiency options from Table R407.1 in order to achieve a minimum of 3 energy credits.
2. Building utilizing the performance path to comply with this code shall use an adjusted annual energy cost that is 97% of the annual energy cost of the standard reference design when calculating Performance-based compliance (R405.3).

**Table R407.1 (IRC N1107.1) ENERGY EFFICIENCY MEASURES**

<table>
<thead>
<tr>
<th>CATEGORY OPT</th>
<th>DESCRIPTION</th>
<th>CREDITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>a Attic Insulation R-38</td>
<td>0.5</td>
</tr>
<tr>
<td>1</td>
<td>b Attic Insulation R-49</td>
<td>1</td>
</tr>
<tr>
<td>1</td>
<td>c Attic Insulation R-60</td>
<td>1</td>
</tr>
<tr>
<td>1</td>
<td>d Attic Insulation R-71</td>
<td>1</td>
</tr>
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<td>a Wall Insulation (16 o.c.) R-15</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>b Wall Insulation (16 o.c.) R-13+3</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>c Wall Insulation (16 o.c.) R-20</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>d Wall Insulation (16 o.c.) R-21</td>
<td>1</td>
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<tr>
<td>2</td>
<td>e Wall Insulation (16 o.c.) R-13+5</td>
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</tr>
<tr>
<td>2</td>
<td>f Wall Insulation (16 o.c.) R-15+5</td>
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</tr>
<tr>
<td>2</td>
<td>g Wall Insulation (16 o.c.) R-23 BIB</td>
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<tr>
<td>2</td>
<td>h Wall Insulation (16 o.c.) R-13+10</td>
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<td>2</td>
<td>i Wall Insulation (16 o.c.) R-20+5</td>
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<td>Wall Insulation (24 o.c.) R-20+10</td>
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<td>q</td>
<td>Wall Insulation (24 o.c.) R-30+10</td>
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<td>a</td>
<td>Mass Wall R-6 c.i.</td>
</tr>
<tr>
<td>3</td>
<td>b</td>
<td>Mass Wall (16 o.c.) R-13</td>
</tr>
<tr>
<td>3</td>
<td>c</td>
<td>Mass Wall (16 o.c.) R-20</td>
</tr>
<tr>
<td>3</td>
<td>d</td>
<td>Mass Wall R-12 c.i.</td>
</tr>
<tr>
<td>4</td>
<td>a</td>
<td>Basement Wall R-5 ci</td>
</tr>
<tr>
<td>4</td>
<td>b</td>
<td>Basement Wall R-10 ci</td>
</tr>
<tr>
<td>4</td>
<td>c</td>
<td>Basement Wall R-13</td>
</tr>
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<td>d</td>
<td>Basement Wall R-15</td>
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<td>e</td>
<td>Basement Wall R-19</td>
</tr>
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<td>4</td>
<td>f</td>
<td>Basement Wall R-20</td>
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</tr>
<tr>
<td>4</td>
<td>h</td>
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</tr>
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<td>i</td>
<td>Basement Wall R-30 ccSPF</td>
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<td>Slab Edge R-10, 2 ft depth</td>
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<td>5</td>
<td>b</td>
<td>Slab Edge R-10, 4 ft depth</td>
</tr>
<tr>
<td>5</td>
<td>c</td>
<td>Slab Edge R-15, 4 ft depth</td>
</tr>
<tr>
<td>6</td>
<td>a</td>
<td>Windows U-0.40, SHGC-0.25</td>
</tr>
<tr>
<td>6</td>
<td>b</td>
<td>Windows U-0.32, SHGC-0.25</td>
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<td>6</td>
<td>c</td>
<td>Windows U-0.30, SHGC-0.25</td>
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<td>d</td>
<td>Windows U-0.27, SHGC-0.25</td>
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<td>Windows U-0.30, SHGC-0.40</td>
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<td>i</td>
<td>Windows U-0.12, SHGC-0.40</td>
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<td>a</td>
<td>Tightness- 4 ACH50</td>
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<td>Tightness- 1.5 ACH50</td>
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<td>Tightness- 0.6 ACH50</td>
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<td>8</td>
<td>a</td>
<td>Ducts in Attic: Reduced Leakage ≤2cfm/100@25°C</td>
</tr>
<tr>
<td>8</td>
<td>b</td>
<td>Compact Layout: duct surface area ≤15% of conditioned floor area for supply ducts and ≤4% for return ducts</td>
</tr>
<tr>
<td>8</td>
<td>c</td>
<td>Compact Layout + Reduced Leakage</td>
</tr>
<tr>
<td>8</td>
<td>d</td>
<td>Deeply Buried Ducts, in accordance with 2018 IECC section R403.3.6.1</td>
</tr>
<tr>
<td>8</td>
<td>e</td>
<td>Compact Layout + Deeply Buried</td>
</tr>
<tr>
<td>8</td>
<td>f</td>
<td>Compact + Deeply Buried Ducts + Reduced Leakage</td>
</tr>
<tr>
<td>8</td>
<td>g</td>
<td>Ducts 100% Inside Conditioned Space</td>
</tr>
<tr>
<td>9</td>
<td>a</td>
<td>Radiant Barrier- Roof Deck</td>
</tr>
<tr>
<td>10</td>
<td>a</td>
<td>Furnace or Boiler- 92 AFUE, PSC</td>
</tr>
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<td>b</td>
<td>Furnace or Boiler- 92 AFUE, ECM</td>
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<td>c</td>
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<td>11</td>
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<td>Air Conditioner 24 SEER</td>
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<td>12</td>
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<td>Heat Pump 15 SEER/8.5 HSPF</td>
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<td>d</td>
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<td>Heat Pump 24 SEER/10 HSPF</td>
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<td>Energy Star Gas, 40 gal, med draw., 0.65 UEF/0.64 EF</td>
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<tr>
<td>13</td>
<td>b</td>
<td>Gas instantaneous, 0.81 UEF/EF</td>
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<td>c</td>
<td>Energy Star Gas instantaneous, 0.87 UEF/EF</td>
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<tr>
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<td>d</td>
<td>High Eff Gas instantaneous, 0.9 UEF/EF</td>
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<td>Energy Star elec heat pump, 50 gal, 2.0 UEF/1.82 EF</td>
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<tr>
<td>13</td>
<td>f</td>
<td>High Eff elec heat pump, 50 gal, 3.1 UEF/3.2 EF</td>
</tr>
<tr>
<td>14</td>
<td>a</td>
<td>LED 95% interior, exterior, garage</td>
</tr>
</tbody>
</table>

- a. Only one item in each Category can be counted.
- b. CZ4 includes Climate Zone 4 except Climate Zone 4 Marine.
- c. CZ5 includes Climate Zone 5 and Climate Zone 4 Marine.
- d. R-values are minimum averages.
- e. U-factors and SHGC are maximum weighted averages (exception: SHGC permitted to be higher in climate zones 5-8).
- f. Building tightness and duct tightness are maximum.
- g. Effectiveness, AFUE, SEER, HSPF, EF are minimums.
- h. Cells containing a dash (-) indicate zero credits because that measure is the baseline requirement or was not shown to improve energy savings.
- i. For any measure where the installed efficiency value falls between two thresholds from the table, credit shall be taken for the highest threshold that the installed value meets or exceeds.
- j. Measured leakage is outside conditioned space.
- k. Radiant Barriers shall comply with IBC Section 1509 and shall be installed over the entire roof deck over conditioned space.

Revise as follows:

**TABLE R405.5.2(1) [IRC N1105.5.2(1)]**
<table>
<thead>
<tr>
<th>BUILDING COMPONENT</th>
<th>STANDARD REFERENCE DESIGN</th>
<th>PROPOSED DESIGN</th>
</tr>
</thead>
<tbody>
<tr>
<td>Above-grade walls</td>
<td>Type: mass, where the proposed wall is a mass wall; otherwise, wood frame.</td>
<td>As proposed</td>
</tr>
<tr>
<td></td>
<td>Gross area: same as proposed.</td>
<td>As proposed</td>
</tr>
<tr>
<td></td>
<td>U-factor: as specified in Table R402.1.4.</td>
<td>As proposed</td>
</tr>
<tr>
<td></td>
<td>Solar absorptance = 0.75.</td>
<td>As proposed</td>
</tr>
<tr>
<td></td>
<td>Emittance = 0.90.</td>
<td>As proposed</td>
</tr>
<tr>
<td>Basement and crawl space walls</td>
<td>Type: same as proposed.</td>
<td>As proposed</td>
</tr>
<tr>
<td></td>
<td>Gross area: same as proposed.</td>
<td>As proposed</td>
</tr>
<tr>
<td></td>
<td>U-factor: as specified in Table R402.1.4, with the insulation layer on the interior side of the walls.</td>
<td>As proposed</td>
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<tr>
<td>Above-grade floors</td>
<td>Type: wood frame.</td>
<td>As proposed</td>
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<tr>
<td></td>
<td>Gross area: same as proposed.</td>
<td>As proposed</td>
</tr>
<tr>
<td></td>
<td>U-factor: as specified in Table R402.1.4.</td>
<td>As proposed</td>
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<tr>
<td>Ceilings</td>
<td>Type: wood frame.</td>
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<tr>
<td></td>
<td>Gross area: same as proposed.</td>
<td>As proposed</td>
</tr>
<tr>
<td></td>
<td>U-factor: as specified in Table R402.1.4.</td>
<td>As proposed</td>
</tr>
<tr>
<td>Roofs</td>
<td>Type: composition shingle on wood sheathing.</td>
<td>As proposed</td>
</tr>
<tr>
<td></td>
<td>Gross area: same as proposed.</td>
<td>As proposed</td>
</tr>
<tr>
<td></td>
<td>Solar absorptance = 0.75.</td>
<td>As proposed</td>
</tr>
<tr>
<td></td>
<td>Emittance = 0.90.</td>
<td>As proposed</td>
</tr>
<tr>
<td>Attics</td>
<td>Type: vented with an aperture of 1 ft(^2) per 300 ft(^2) of ceiling area.</td>
<td>As proposed</td>
</tr>
<tr>
<td>Foundations</td>
<td>Type: same as proposed.</td>
<td>As proposed</td>
</tr>
<tr>
<td></td>
<td>Foundation wall area above and below grade and soil characteristics: same as proposed.</td>
<td>As proposed</td>
</tr>
<tr>
<td>Opaque doors</td>
<td>Area: 40 ft(^2).</td>
<td>As proposed</td>
</tr>
<tr>
<td></td>
<td>Orientation: North.</td>
<td>As proposed</td>
</tr>
<tr>
<td></td>
<td>U-factor: same as fenestration as specified Table R402.1.4.</td>
<td>As proposed</td>
</tr>
</tbody>
</table>
| Vertical fenestration other than opaque doors | Total area\(^a\):  
(a) The proposed glazing area, where the proposed glazing area is less than 15 percent of the conditioned floor area  
(b) 15 percent of the conditioned floor area, where the proposed glazing area is 15 percent or more of the conditioned floor area. | As proposed      |
<p>|                          | Orientation: equally distributed to four cardinal compass orientations (N, E, S &amp; W).     | As proposed      |
|                          | U-factor: as specified in Table R402.1.4.                                                | As proposed      |
|                          | SHGC: as specified in Table R402.1.2 except for climate zones without an SHGC requirement, the SHGC shall be equal to 0.40. | As proposed      |
|                          | Interior shade fraction: 0.92-(0.21 × SHGC for the standard reference design).           | Interior shade fraction: 0.92-(0.21 × SHGC as proposed) |
|                          | External shading: none.                                                                   | As proposed      |
| Skylights                | None.                                                                                    | As proposed      |
| Thermally isolated sunrooms | None.                                                                                     | As proposed      |</p>
<table>
<thead>
<tr>
<th>Topic</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Air exchange rate</strong></td>
<td>The air leakage rate at a pressure of 0.2 inch w.g. (50 Pa) shall be 5 air changes per hour. Climate Zones 3 through 8: 3 air changes per hour. The mechanical ventilation rate shall be in addition to the air leakage rate and shall be the same as in the proposed design, but not greater than (0.01 \times \text{CFA} + 7.5 \times (N_{bx} + 1)) where: (\text{CFA} = \text{conditioned floor area, ft}^2). (N_{bx} = \text{number of bedrooms}). Energy recovery shall not be assumed for mechanical ventilation.</td>
</tr>
<tr>
<td><strong>Mechanical ventilation</strong></td>
<td>Where mechanical ventilation is not specified in the proposed design: None Where mechanical ventilation is specified in the proposed design, the annual vent fan energy use, in units of kWh/yr, shall equal: (\left(\frac{\text{e}}{1.0876}\right) \times \left[0.0876 \times \text{CFA} + 65.7 \times (N_{bx} + 1)\right]) where: (\text{e} = \text{the minimum exhaust fan efficacy, as specified in Table R403.6.1, corresponding to a flow rate of } 0.01 \times \text{CFA} + 7.5 \times (N_{bx} + 1)) (\text{CFA} = \text{conditioned floor area, ft}^2). (N_{bx} = \text{number of bedrooms}).</td>
</tr>
<tr>
<td><strong>Internal gains</strong></td>
<td>(\text{IGain, in units of Btu/day per dwelling unit, shall equal: } 17,900 + 23.8 \times \text{CFA} + 4,104 \times N_{bx}) where: (\text{CFA} = \text{conditioned floor area, ft}^2). (N_{bx} = \text{number of bedrooms}).</td>
</tr>
<tr>
<td><strong>Internal mass</strong></td>
<td>Internal mass for furniture and contents: 8 pounds per square foot of floor area. Same as standard reference design.</td>
</tr>
<tr>
<td><strong>Structural mass</strong></td>
<td>For masonry floor slabs: 80 percent of floor area covered by R-2 carpet and pad, and 20 percent of floor directly exposed to room air. As proposed For masonry basement walls: as proposed, but with insulation as specified in Table R402.1.4, located on the interior side of the walls. As proposed For other walls, ceilings, floors, and interior walls: wood frame construction. As proposed</td>
</tr>
</tbody>
</table>
| **Heating systems** | For other than electric heating without a heat pump: as proposed. Where the proposed design utilizes electric heating without a heat pump, the standard reference design shall be an air source heat pump meeting the requirements of Section C403 of the IECC—Commercial Provisions.  
Capacity: sized in accordance with Section R403.7.  
Fuel Type/Capacity: Same as proposed design.  
Efficiencies:  
Electric: air source heat pump complying with prevailing federal minimum standards  
Nonelectric furnaces: natural gas furnace complying with prevailing federal minimum standards  
Nonelectric boilers: natural gas boiler complying with prevailing federal minimum efficiencies. |
|---|---|
| **Cooling systems** | As proposed. Capacity: sized in accordance with Section R403.7.  
Fuel Type/Capacity: Same as proposed design  
Efficiency: complying with federal minimum standards |
| **Service water heating** | As proposed. Use: same as proposed design.  
Fuel type: Same as proposed design  
Efficiency: complying with prevailing federal minimum standards  
Use: gal/day = 30 + 10 x Nbr  
Tank temperature: 120°F |
| **Thermal distribution systems** | Duct insulation: in accordance with Section R403.3.1. A thermal distribution system efficiency (DSE) of 0.88 shall be applied to both the heating and cooling system efficiencies for all systems other than tested duct systems.  
Exception: For nonducted heating and cooling systems that do not have a fan, the standard reference design thermal distribution system efficiency (DSE) shall be 1.  
For tested duct systems, the leakage rate shall be 4 cfm (113.3 L/min) per 100 ft² (9.29 m²) of conditioned floor area at a pressure of differential of 0.1 inch w.g. (25 Pa).  
Duct insulation: as proposed. As tested or, where not tested, as specified in Table R405.5.2(2) |
| **Thermostat** | Type: Manual, cooling temperature setpoint = 75°F; heating temperature setpoint = 72°F. Same as standard reference design. |

For SI: 1 square foot = 0.93 m², 1 British thermal unit = 1055 J, 1 pound per square foot = 4.88 kg/m², 1 gallon (US) = 3.785 L, 

\[ ^\circ C = \left( ^\circ F - 32 \right) / 1.8, \text{ 1 degree} = 0.79 \text{ rad.} \]

a. Where required by the code official, testing shall be conducted by an approved party. Hourly calculations as specified in the ASHRAE Handbook of Fundamentals, or the equivalent, shall be used to determine the energy loads resulting from infiltration.

c. Thermal storage element shall mean a component that is not part of the floors, walls or ceilings that is part of a passive solar system, and that provides thermal storage such as enclosed water columns, rock beds, or phase-change containers. A thermal storage element shall be in the same room as fenestration that faces within 15 degrees (0.26 rad) of true south, or shall be connected to such a room with pipes or ducts that allow the element to be actively charged.

d. For a proposed design with multiple heating, cooling or water heating systems using different fuel types, the applicable standard reference design system capacities and fuel types shall be weighted in accordance with their respective loads as calculated by accepted engineering practice for each equipment and fuel type present.

e. For a proposed design without a proposed heating system, a heating system having the prevailing federal minimum efficiency shall be assumed for both the standard reference design and proposed design.

f. For a proposed design home without a proposed cooling system, an electric air conditioner having the prevailing federal minimum efficiency shall be assumed for both the standard reference design and the proposed design.

g. For a proposed design with a nonstorage-type water heater, a 40-gallon storage-type water heater having the prevailing federal minimum energy factor for the same fuel as the predominant heating fuel type shall be assumed. For a proposed design without a proposed water heater, a 40-gallon storage-type water heater having the prevailing federal minimum efficiency for the same fuel as the predominant heating fuel type shall be assumed for both the proposed design and standard reference design.

h. For residences with conditioned basements, R-2 and R-4 residences, and for townhouses, the following formula shall be used to determine glazing area:

\[ AF = A_s \times FA \times F \]

where:

- \( AF \) = Total glazing area.
- \( A_s \) = Standard reference design total glazing area.
- \( FA \) = (Above-grade thermal boundary gross wall area)/(above-grade boundary wall area + 0.5 × below-grade boundary wall area).
- \( F \) = (above-grade thermal boundary wall area)/(above-grade thermal boundary wall area + common wall area) or 0.56, whichever is greater.

and where:

- Thermal boundary wall is any wall that separates conditioned space from unconditioned space or ambient conditions.
- Above-grade thermal boundary wall is any thermal boundary wall component not in contact with soil.
- Below-grade boundary wall is any thermal boundary wall in soil contact.
- Common wall area is the area of walls shared with an adjoining dwelling unit.

\( L \) and \( CFA \) are in the same units.

Reason: This proposal introduces a new section within the code that will require additional efficiency measures (options) for residential buildings. When taking the prescriptive approach, options from the table with assigned credit values must be selected in order to achieve 3 credits. For the performance approach, the same number of percentage number will reduce the annual energy cost for the standard reference design. The ERI path has not been included in this proposal as it is currently the most stringent path in the code.

The energy efficiency measures listed in Table 407.1 were analyzed using Ekotrope Rater modeling software (v3.1.0) to estimate energy savings relative to a 2018 IECC prescriptive reference house baseline. The energy modeling was performed by Home Innovation Research Labs. For all building characteristics not defined in the IECC, the “Methodology for Calculating Energy Use in Residential Buildings” was followed. This Methodology was developed in 2012 by Home Innovation Research Labs (formerly NAHB Research Center) to provide guidance, uniformity, and practical construction and equipment choices for researchers comparing the energy performance differences resulting from potential code changes.

A two-story single-family house (2,352 square feet above grade) was analyzed in 9 different locations across climate zones 1 through 7. For each location, multiple house configurations were analyzed to capture the effects of regionally-typical foundations and wall construction types. An all-electric house and a house with gas space heating and gas water heating were analyzed, resulting in 48 baseline designs for each of these configurations. Climate-appropriate energy conservation measures (ECMs) were analyzed individually for each unique house configuration for each location, resulting in more than 2,200 discrete designs covering all major aspects of building envelope construction, air tightness, equipment efficiencies and lighting and appliances. The credits in Table 407.1 were assigned as the weighted averages of the estimated whole-building energy savings (%) for each house configuration for the location. The weighting was based on regional market data. The credits are the result of weighted average whole-building energy savings rounded down to a 0.5% increment; except where the total energy savings ranged between 0.4% and 0.5%.
In addition to individual measures, select packages of measures were also simulated for analysis across several climate zones. The comparison of additive energy savings from individual measures and the modeled net savings from packages of the same measures indicated that at the proposed 3% incremental levels of improvement, a simple addition of energy savings from individual measures is an adequate representation of their combined efficiency.

The energy performance target of 3% (or 3 credits) represents an incremental level of improvement that can be achieved through one or more compliance options (individual measures or a combination of measures) that meet the cost effectiveness metrics of simple payback of 10-15 years depending on the type of the measure.

The required credits and the paths to achieve these efficiency gains have been determined using current cost data provided by homebuilders from across the U.S. to have at a minimum a 10-year simple payback and to be cost effective when using the life cycle analysis method.

**Cost Impact:** The code change proposal will increase the cost of construction
This proposal will increase the cost of construction. However, it has been determined, using current homebuilder cost data, that this proposal provides paths with at least a 10-year (or better) simple payback. This proposal has also been determined to be cost effective using the life cycle analysis method.
Proposed changes to the 2018 International Energy Conservation Code:

R401.2 Compliance. Projects shall comply with Section R401.2.1 and one of the following:

1. Sections R401 through R404.
2. Section R405 and the provisions of Sections R401 through R404 indicated as “Mandatory.”
3. The energy rating index (ERI) approach in Section R406.

Add new text as follows:

R401.2.1 Additional Energy Efficiency (Mandatory). This section establishes additional requirements applicable to all compliance approaches to achieve additional energy efficiency.

1. For buildings complying under Sections R401 through R404, one of the Additional Efficiency Package Options shall be installed according to Section R407.2.
2. For buildings complying under the simulated performance alternative in Section R405, the building shall meet one of the following:
   2.1. One of the Additional Efficiency Package Options in Section R407.2 shall be installed without including such measures in the proposed design under Section R405; or
   2.2. The proposed design of the building under Section R405.3 shall have an annual energy cost that is less than or equal to 95 percent of the annual energy cost of the standard reference design.
3. For buildings complying under the energy rating index alternative in Section R406, the energy rating index value shall be at least 5 percent less than the energy rating index target specified in Table R406.4.

The option selected for compliance shall be identified in the Certificate required by Section R401.3.

SECTION R407
ADDITIONAL EFFICIENCY PACKAGE OPTIONS

R407.1 Scope. This section establishes Additional Efficiency Package Options to achieve additional energy efficiency in accordance with Section R401.2.1.

R407.2 Additional Efficiency Package Options. Additional efficiency package options for compliance with Section R401.2.1 are set forth in Sections R407.2.1 through R407.2.5.

R407.2.1 Enhanced envelope performance option. The total building thermal envelope UA, the sum of U-factor times assembly area, shall be less than or equal to 95 percent of the total UA resulting from multiplying the U-factors in Table R402.1.4 by the same assembly area as in the proposed building. The UA calculation shall be performed in accordance with Section R402.1.5. The area-weighted average SHGC of all glazed fenestration shall be less than or equal to 95 percent of the maximum glazed fenestration SHGC in Table R402.1.2.

R407.2.2 More efficient HVAC equipment performance option. Heating and cooling equipment shall meet or exceed one of the following efficiencies:

1. Greater than or equal to 95 AFUE natural gas furnace and 16 SEER air conditioner.
2. Greater than or equal to 10 HSPF / 16 SEER air source heat pump.
3. Greater than or equal to 3.5 COP ground source heat pump.

For multiple cooling systems, all systems shall meet or exceed the minimum efficiency requirements in this section and shall be sized to serve 100 percent of the cooling design load. For multiple heating systems, all systems shall meet or exceed the minimum efficiency requirements in this section and shall be sized to serve 100 percent of the heating design load.

R407.2.3 Reduced energy use in service water heating option. The hot water system shall meet or exceed one of the following efficiencies:

1. Greater than or equal to 82 EF fossil fuel service water heating system.
2. Greater than or equal to 2.0 EF electric service water heating system.
3. Greater than or equal to 0.4 Solar Fraction solar water heating system.
**R407.2.4 More efficient duct thermal distribution system option.** The thermal distribution system shall meet or exceed one of the following efficiencies:

1. 100 percent of ducts and air handlers located entirely within the building thermal envelope.
2. 100 percent of ductless thermal distribution system or hydronic thermal distribution system located completely inside the building thermal envelope.
3. 100 percent of duct thermal distribution system located in conditioned space as defined by Section R403.7.

**R407.2.5 Improved air sealing and efficient ventilation system option.** The measured air leakage rate shall be less than or equal to 3.0 ACH50, with either an Energy Recovery Ventilator (ERV) or Heat Recovery Ventilator (HRV) installed. Minimum HRV and ERV requirements, measured at the lowest tested net supply airflow, shall be greater than or equal to 75 percent Sensible Recovery Efficiency (SRE), less than or equal to 1.1 W/CFM Fan Energy and shall not use recirculation as a defrost strategy. In addition, the ERV shall be greater than or equal to 50 percent Latent Recovery/Moisture Transfer (LRMT).

**Reason:** The purpose of this code change proposal is to improve the energy efficiency of residential buildings by roughly 5% or more, and to provide code users with flexibility to select the measures that make the most sense for each project. This proposal largely mirrors the format of Section C406 Additional Efficiency Package Options—an approach to improving commercial buildings that has been included in the commercial energy code since the 2012 IECC. Like Section C406, new Section R407 offers multiple straightforward improvements that will increase energy savings and reduce costs to the homeowner over the useful life of the building. In addition, Section R401.2.1 provides two additional means of demonstrating compliance: 1) code users may achieve a 5% improvement in the performance path; or 2) code users may comply by applying a 5% improvement in ERI Target score. The range of options will provide multiple paths for projects to achieve the intended improvement in the code. The technologies included in the packages of improvements are currently available in the relevant markets and the improved building practices have been proven feasible in residential buildings. However, many of these measures would be difficult to include in the current code format because of federal preemption of covered products, inapplicability to certain home designs, or other limitations. This proposal follows the lead of states like Oregon and Washington that have successfully created a list of options available to builders to meet the residential code improvements. This approach increases flexibility for code users while advancing the code's efficiency baseline.

Although the historic energy efficiency gains in the 2009 and 2012 IECC have been largely maintained in the 2015 and 2018 IECC, there is a clear need for more substantial improvements in the 2021 IECC. It is well understood that buildings have an outsized impact on the nation's energy demands. Buildings consume 42% of the nation's energy, including 54% of the nation's natural gas and 71% of its electricity. The nation's policymakers are increasingly turning to building energy codes as a means of addressing energy and climate goals. Several states have adopted improvements beyond the 2018 IECC, and the U.S. Conference of Mayors recently called for “putting future triennial IECC updates on a ‘glide path’ of steady efficiency gains that will improve the efficiency performance of millions of U.S. residential, multi-family, and commercial buildings.” See 2018 U.S.C.M. Resolution 86 (June 11, 2018). While a much larger improvement in overall efficiency is warranted, a roughly 5% improvement through the adoption of this proposal would be a step in the right direction.

This proposal provides policymakers with additional options for improving the code going forward. A jurisdiction could increase the number of required options (and make a corresponding increase in the performance path and ERI required improvement). And as additional technologies and building methods become available, more options may be added to the initial list of improvements. (For example, Section C406 was expanded from 5 to 8 options in the 2018 IECC.) In sum, this proposal will allow the IECC to build upon recent improvements and create a new model for improving and adding flexibility to residential building energy codes going forward.


**Cost Impact:** The code change proposal will increase the cost of construction. For each climate zone, there are cost-effective options available that will generate energy savings and be cost effective over the useful life of the building. Although the savings will vary based on the option selected and design choices made in the building, there are multiple sensible options for achieving improved efficiency in each climate zone. On a broader scale, these improvements will help curb the nation's increasing demands for energy and contribute to a more secure energy future.
SECTION R407 (IRC N1107)  
PATHWAY TO ZERO, ENERGY RATING INDEX COMPLIANCE ALTERNATIVE

R407.1 (IRC N1107.1) Scope. This section establishes criteria for jurisdictions to attain zero energy compliance using an Energy Rating Index (ERI) analysis by the year 2042.

R407.2 (N1107.2) Mandatory requirements. Compliance with this section requires that the provisions identified in Sections R401 through R404 indicated as “Mandatory” be met.

Exception: Supply and return ducts not completely inside the building thermal envelope shall be insulated to an R-value of not less than R-8.

R407.3 (IRC N1107.3) Energy Rating Index. The Energy Rating Index (ERI) shall be determined in accordance with RESNET/ANSI/ICC 301 except for buildings covered by the International Residential Code, the ERI Reference Design Ventilation rate shall be in accordance with Equation 4-2.

Ventilation rate, CFM = (0.01 × total square foot area of house) + [7.5 × (number of bedrooms + 1)]  
(Equation 4-2)

Energy used to recharge or refuel a vehicle used for transportation on roads that are not on the building site shall not be included in the ERI reference design or the rated design.

R407.4 (IRC N1107.4) ERI-based compliance. Compliance based on an ERI analysis requires that the rated proposed design and confirmed built dwelling be shown to have a score less than or equal to the values in Table R407.4, for the ERI implementation date, when compared to the ERI reference design for each of the following conditions:

1. ERI value without on-site renewable energy generation
2. ERI value with on-site renewable energy generation

<table>
<thead>
<tr>
<th>ERI Implementation date</th>
<th>ENERGY RATING INDEX WITHOUT ON-SITE RENEWABLES</th>
<th>ENERGY RATING INDEX WITH ON-SITE RENEWABLES</th>
</tr>
</thead>
<tbody>
<tr>
<td>January 1st 2021</td>
<td>60</td>
<td>55</td>
</tr>
<tr>
<td>January 1st 2024</td>
<td>55</td>
<td>50</td>
</tr>
<tr>
<td>January 1st 2027</td>
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<td>45</td>
</tr>
<tr>
<td>January 1st 2030</td>
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</tr>
<tr>
<td>January 1st 2033</td>
<td>40</td>
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</tr>
<tr>
<td>January 1st 2036</td>
<td>--</td>
<td>20</td>
</tr>
<tr>
<td>January 1st 2039</td>
<td>--</td>
<td>10</td>
</tr>
<tr>
<td>January 1st 2042</td>
<td>--</td>
<td>0</td>
</tr>
</tbody>
</table>

Table R407.4 (IRC N1107.4)  
MAXIMUM ENERGY RATING INDEX

a. The maximum ERI without on-site renewables is fixed at an ERI of 40 after January 1st 2036, because thermal envelope and mechanical improvements cannot lower the ERI score significantly below that level.

b. The maximum ERI with on-site renewables can be achieved with or without installing onsite renewables until January 1st 2033 when on-site renewables are required to be used to lower the ERI below 40.

R407.5 (IRC N1107.5) Verification by an approved agency. Verification of compliance with the Section R407 as outlined in Section R407.4 and R407.6 shall be completed by an approved third party. Verification of Section R407.4 shall be completed by the authority having jurisdiction or an approved third party inspection agency per Section R105.4.

R407.6 (IRC N1107.6) Documentation. Documentation of the software used to determine the ERI and the parameters for the residential building shall be in accordance with Sections R407.6.1 through R407.6.3.


R407.6.1 (IRC N1107.6.1) Compliance software tools. Software tools used for determining ERI shall be approved software rating tools in accordance with RESNET/ICC 301.

R407.6.2 (IRC N1107.6.2) Compliance report. Compliance software tools shall generate a report that documents that the home and ERI score complies with Sections R407.2 through Section R407.4. The compliance documentation shall be created for the proposed design and submitted with the application for the building permit. Confirmed compliance documents of the built dwelling unit shall be created and submitted to the code official for review before a certificate of occupancy is issued. Compliance reports shall include information in accordance with Sections R407.6.2.1 and R407.6.2.2.

R407.6.2.1 (IRC N1107.6.2.1) Proposed Compliance report for permit application. Compliance reports submitted with the application for a building permit shall include the following:

1. Building street address, or other building site identification.
2. The name of the individual performing the analysis and generating the compliance report.
3. The name and version of the compliance software tool.
4. If requested by the authority having jurisdiction, documentation of all inputs entered into the software used to produce the results for the reference design and/or the rated home.
5. A certificate indicating that the proposed design has an ERI less than or equal to the appropriate scores indicated in Table R407.4 when compared to the ERI reference design. The certificate shall document the building component energy specifications that are included in the calculation including, component level insulation R-values or U-factors, assumed duct system and building envelope air leakage testing results, as well as the type and rated efficiencies of proposed heating, cooling, mechanical ventilation, and service water heating equipment to be installed. The type and production size of the proposed onsite renewable Energy systems shall be reported.
6. When a site-specific report is not generated, the proposed design shall be based on the worst-case orientation and configuration of the rated home.

R407.6.2.2 (IRC N1107.6.2.2) Confirmed Compliance report for a certificate of occupancy. A confirmed compliance report submitted for obtaining the certificate of occupancy shall be made site and address specific and include the following:

1. Building street address, or other building site identification.
2. The name of the individual performing the analysis and generating the report.
3. The name and version of the compliance software tool.
4. If requested by the authority having jurisdiction, documentation of all inputs entered into the software used to produce the results for the reference design and/or the rated home.
5. A final confirmed certificate indicating that the confirmed rated design of the built home complies with Sections R407.2 and R407.4. The certificate shall report the energy features that were confirmed to be in the home including component level insulation R-values or U-factors, results from any required duct system and building envelope air leakage testing, as well as, the type and rated efficiencies of the heating, cooling, mechanical ventilation, and service water heating equipment installed. The type and production size of the confirmed onsite renewable energy systems shall be reported.

R407.6.3 (IRC N1107.6.3) Additional Documentation. The code official shall be permitted to require the following Documents:

1. Documentation of the building component characteristics of the ERI reference design.
2. A certification signed by the builder providing the building component characteristics of the rated design.
3. Documentation of the actual values used in the software calculation for the rated design.

R407.6.4 (IRC N1107.6.4) Specific Approval. Performance analysis tools meeting the applicable section of Section R407 shall be approved. Documentation demonstrating the approval of the performance analysis with Section R407.6.1 shall be provided.

R407.6.5 (IRC N407.6.5) Input values. Where calculation require input values not specified by Sections R402, R403, R404 and R405, those input values shall be taken from RESNET/ICC 301.

Reason: As the Energy Rating Index (ERI) diverges from the Home Energy Rating System Index (HERS) it becomes important to realize that although there are commonalities between the two, they are ultimately different from each other and should be thought of separately. As soon as the R406 ERI pathway was codified it locked in the ERI to a specific version of the RESNET/ANSI/ICC 301 standard while the HERS Index is based on a continually maintained version of the same ANSI 301 standard. Therefore, we now have divergent index scores that mean different things. The HERS Index benchmarks the efficiency of a home in comparison to a reference home that is based on the 2006 IECC. A HERS Rating is an asset rating of the energy features in a home. This means that in the process of a HERS Rating to generate the HERS Index a Rater does not necessarily inspect to see if energy features governed by the code are installed according to requirements of the code. For example, the HERS Ratings systems’ insulation installation grading criteria gives guidance on how to de-rate the R-value of poorly installed insulation. The Rater is required to give a grade 3 to poor installations. The HERS Index score is intended to evaluate the performance of what is installed. It is not intended to determine if it was installed per the requirement of code. A code rating or evaluation for the generation of the ERI score, on the other hand, should only use a grade 1 because only grade 1 installation of insulation meets the requirements of manufacturer instructions and therefore code. If a Rater were to evaluate a home for an ERI score and come across grade 3 installation of insulation, the installation should fail the inspection and be reinstalled to meet code requirements. In this way, an ERI rating and a HERS rating are fundamentally different. One is held to a pass/fail requirement of code and the other is a quantification and evaluation of energy assets or components of the home. This small example demonstrates how the HERS index score and the ERI score differ.
Another example that demonstrates a more pronounced difference between the indices is the codified ventilation requirements for the ERI score vs. the ventilation requirements for the HERS Index score. The ERI score uses the ASHRAE 62.2-2010 ventilation requirements while the HERS Index uses the ASHRAE62.2-2013 ventilation requirements. This difference can result in over a 10-point difference in the scores.

Many are troubled by this divergence in the index scores, but I am not because the ERI and the HERS Index are fundamentally different if related systems. The HERS Index has been adopted by builders and the public primarily as a sales and marketing tool and a means to compare the performance of houses. The HERS Index score is quite good for these purposes. The ERI, like the area weighted u-values in section R402.1.5 Total U-factor Alternative, or cost comparison in section R405 Simulated Performance Alternative is a matrix by which a home’s performance can be compared to demonstrate compliance with the code. It is not intended for marketing or public consumption and as the scores continue to diverge the public will continue to be unaware of the ERI score just as they are unaware of area weighted u-values and cost compliance. If a common understanding can be created regarding this point then the ERI score can be a powerful tool to offer great flexibility for builders as well as a path forward for the code and municipalities who choose to use it to achieve greater energy efficiency.

This proposal has been designed to leverage the unique nature of the ERI and the already codified mandatory aspects of the IECC, so as to offer municipalities and builders an option that will continue the trend toward zero energy homes. As Section R407 is an optional pathway municipalities and builders can choose a code compliance path that allows great flexibility in energy specifications and design while the homebuilding industry learns how to incorporate new technologies or better use old ones. The IECC’s emphasis on protecting the thermal envelope is protected not by a punitive R-value backstop, but rather by a before renewables ERI requirement. A Pre-renewables ERI score opens up flexibility through cost-effective energy tradeoffs that are the most flexible for the builder as they would include mechanical, thermal or conductive, convective losses through envelope, along with duct tightness, lights, appliances, and more. Any feature that lowers the ERI can be used. This integrated energy evaluation acknowledges that the ERI of a home cannot be lowered beyond a certain threshold unless renewables are installed, but also sets the pre-renewable ERI at a level that ensures current levels of efficiency will be created as the starting point. For example, when a builder maximizes the thermal envelope and mechanical efficiencies of their design the ERI cannot go lower than approximately 35-40. To get an ERI score below that range on-site renewables must be installed. In this way, R407, as proposed, ensures a sound building envelope and efficient mechanical systems before renewables are considered.

The uniqueness of this proposal is that it creates a timeline by which a clear incremental approach for achieving increases in efficiencies that would lead to zero energy homes can be achieved. Although this will be new to the code development world, it is tremendously important to allow the path to zero to be phased in and for giving builders and jurisdictions a timeline for planning to achieve the ultimate goal. This phased-in approach has precedence in two Colorado jurisdictions. The City of Boulder and Boulder County have both set a phased approach for attaining zero energy in their municipalities.

Section R407 is optional so only those municipalities and builders that are searching for code compliant incremental approaches need take part. It has become a difficult argument to increase R-values, house tightness or duct leakage requirements in the 2021 IECC development cycle. This ERI approach to Zero Energy offers a logical, market-driven approach that creates a timeline for achieving significant increases in efficiency while simultaneously giving industry time to adjust and provide cost-effective solutions. This proposal also guards against building poor thermal envelopes and offsetting with on-site renewable systems. This proposal offers builders the greatest flexibility to choose how to build to meet the requirements of code.

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

This R407 PATHWAY TO ZERO, ENERGY RATING INDEX COMPLIANCE ALTERNATIVE is just that and optional alternative path way to not only demonstrate compliance with the IECC but to help jurisdictions that are interested define a measurable and incremental approach to create zero energy homes. This approach is being used in Colorado although it is true that cost of construction increases it is only required if the jurisdiction chooses to adopt the pathway.
2018 International Energy Conservation Code

SECTION R501 (IRC N1107)

GENERAL

R501.1 (IRC N1107.1.1) Scope. The provisions of this chapter shall control the alteration, repair, addition and change of occupancy of existing buildings and structures.

Revise as follows:

R501.2 (IRC N1107.2) R501.1.1 (IRC N1107.1.1) Existing buildings. General Except as specified in this chapter, this code shall not be used to require the removal, alteration or abandonment of, nor prevent the continued use and maintenance of, an existing building or building system lawfully in existence at the time of adoption of this code. Unaltered portions of the existing building or building supply system shall not be required to comply with this code.

R501.4 (IRC N1107.4) R501.2 (IRC N1107.2) Compliance. Alterations, additions, repairs, additions and or changes of occupancy to, or relocation of, existing buildings and structures shall comply with the provisions for alterations, repairs, additions and changes of occupancy or relocation, respectively, in this code and the International Residential Code, International Building Code, International Existing Building Code, International Fuel Gas Code, International Mechanical Code, International Plumbing Code, International Property Maintenance Code, International Private Sewage Disposal Code and NFPA 70. Sections R502, R503, R504, or R505 respectively in this code. Changes where unconditioned space is changed to conditioned space shall comply with Section R502.

SECTION R502 (IRC N1108)

ADDITIONS

Revise as follows:

R502.1 (IRC N1108.1) General. Additions to an existing building, building system or portion thereof shall conform to the provisions of this code as those provisions relate to new construction without requiring the unaltered portion of the existing building or building system to comply with this code. Additions shall not create an unsafe or hazardous condition or overload existing building systems. An addition shall be deemed to comply with this code where the addition alone complies, where the existing building and addition comply with this code as a single building, or where the building with the addition does not use more energy than the existing building. Additions shall be in accordance with Section R502.1.1. R502.2 or R502.1.2, R502.3

R503.2 (IRC N1108.2) R502.2 (IRC N1108.2) Change in space conditioning. Any nonconditioned or low-energy space that is altered to become conditioned space shall be required to be brought into full compliance with this code.

Exception Exceptions:

1. Where the simulated performance option in Section R405 is used to comply with this section, the annual energy cost of the proposed design is permitted to be 110 percent of the annual energy cost otherwise allowed by Section R405.3.
2. Where unconditioned space is changed to conditioned space, and the building envelope of the addition shall comply where the Total UA, as determined in Section R402.1.5, of the existing building and the addition, and any alterations that are part of the project, is less than or equal to the Total UA generated for the existing building.
3. Where unconditioned space is changed to conditioned space, the addition shall comply where the annual energy cost or energy use of the addition and the existing building, and any alterations that are part of the project, is less than or equal to the annual energy cost of the existing building when modeled in accordance with Section R405. The addition and any alterations that are part of the project shall comply with Section R405 in its entirety.

R502.1.1 (IRC N1108.1.1.1) R502.3 (IRC N1108.3) Prescriptive compliance. Additions shall comply with Sections R502.1.1.1 R502.3.1 through R502.1.1.4, R502.3.4

R502.1.1.1 (IRC N1108.1.1.1) R502.3.1 (IRC N1108.3.1) Building envelope. New building envelope assemblies that are part of the addition shall comply with Sections R402.1, R402.2, R402.3.1 through R402.3.5, and R402.4.

Exception: New envelope assemblies are exempt from the requirements of R402.4.1.2. Where unconditioned space is changed to conditioned space...
space, the building envelope of the addition shall comply where the Total UA, as determined in Section R402.1.5, of the existing building and the addition, and any alterations that are part of the project, is less than or equal to the Total UA generated for the existing building.

R502.1.2 (IRC N1108.1.2) \textbf{R502.3.2 (IRC N1108.3.2) Heating and cooling systems.} New heating, cooling and duct systems that are HVAC ducts newly installed as part of the addition shall comply with Section R403.

\textbf{Exception:} Where ducts from an existing heating and cooling system are extended to an addition, duct systems with less than 40 linear feet (12.19 m) in unconditioned spaces shall not be required to be tested in accordance with Section R403.3.3.

R502.1.1.3 (IRC N1108.1.3.3) \textbf{R502.3.3 (IRC N1108.3.3) Service hot water systems.} New service hot water systems that are part of the addition shall comply with Section R404.4.

R502.1.1.4 (IRC N1108.1.4) \textbf{R502.3.4 (IRC N1108.3.4) Lighting.} New lighting systems that are part of the addition shall comply with Section R404.1.

\textbf{SECTION R503 (IRC 1109) ALTERATIONS}

Revise as follows:

\textbf{R503.1.2 (IRC N1109.1.2) Heating and cooling systems.} New heating, cooling and duct systems that are part of the HVAC ducts newly installed, as part of an alteration shall comply with Section R403.

\textbf{Exception:} Where ducts from an existing heating and cooling system are extended, duct systems with less than 40 linear feet (12.19 m) in unconditioned spaces shall not be required to be tested in accordance with Section R403.3.3.

\textbf{SECTION R505 (IRC N1111) CHANGE OF OCCUPANCY OR USE}

Delete without substitution:

R505.1 General. Spaces undergoing a change in occupancy that would result in an increase in demand for either fossil fuel or electrical energy shall comply with this code.

Revise as follows:

R505.2 (IRC N1111.2) \textbf{R505.1 (IRC N1111.1) General.} Any space that is converted to a dwelling unit or portion thereof from another use or occupancy shall comply with this code.

\textbf{Exception:} Where the simulated performance option in Section R405 is used to comply with this section, the annual energy cost of the proposed design is permitted to be 110 percent of the annual energy cost allowed by Section R405.3.

Add new text as follows:

\textbf{R505.1.1 (IRC N1111.1.1) Nonconditioned Space} Any nonconditioned or low-energy space that is altered to become a conditioned space shall comply with Section R502.

\textbf{Reason:} No advantage to any proprietary interests governed by the code is intended. The intent is strictly to make the IECC more understandable and easier to use; or, where technical change is proposed, to make the code more reasonable.

Unlike the bulk of proposed SEHPCAC changes this proposal does have two technical changes incorporated:

\begin{itemize}
  \item It removes the requirement for additions to be air leakage tested per Sec. R402.4.1.2 Testing. It is unreasonable to expect an addition to comply with air leakage testing when it is likely open to existing, and potentially much older, unsealed residential space.
  \item It removes the requirement for duct leakage testing on duct extensions. It is unreasonable to expect the sealing of sections of older, potentially concealed, existing ducts from which new duct is to extend.
\end{itemize}

This change also:

\begin{itemize}
  \item Clarifies changes from unconditioned space to condition space must comply as additions.
  \item Consolidates all compliance provisions related to changes from unconditioned to conditioned space.
\end{itemize}
This proposal is submitted by the ICC Sustainable, Energy and High Performance Code Action Committee (SEHPCAC). The SEHPCAC was established by the ICC Board of Directors to pursue opportunities to improve and enhance International Codes with regard to sustainability, energy and high performance as it relates to the built environment included, but not limited to, how these criteria relate to the International Green Construction Code (IGCC) and the International Energy Conservation Code (IECC). In 2018-2019, the SEHPCAC has held five two- or three-day open meetings and numerous workgroup calls, to discuss and debate proposed changes and public comments. Attendees at the meetings and calls included members of the SEHPCAC as well as any interested parties. Related documentation and reports are posted on the SEHPCAC website at: http://www.iccsafe.org/cs/SEHPCAC/Pages/default.aspx

**Cost Impact:** The code change proposal will not increase or decrease the cost of construction
The two exemptions provided do not functionally change construction practices, neither the duct leakage of duct extensions and air leakage testing of envelope assemblies on additions is not feasible and therefore not current practice.

Proposal # 4699

RE211-19
SECTION R502

ADDITIONS

Revise as follows:

R502.1 (IRC N1108.1) General. Additions to an existing building, building system or portion thereof shall conform to the provisions of this code as those provisions relate to new construction without requiring the unaltered portion of the existing building or building system to comply with this code unless required to do so by the chosen compliance pathway. Additions shall not create an unsafe or hazardous condition or overload existing building systems. An addition shall be deemed to comply with this code where the addition alone complies, where the existing building and addition comply with this code as a single building, or where the building with the addition does not use more energy than the existing building. Additions shall be in accordance with Section R502.1.1 or R502.1.2, by using either the prescriptive path in Section R502.1.1, simulated performance path in Section R502.1.2, or the energy rating index path in Section R502.1.3.

R502.1.1 (IRC N1108.1.1) Prescriptive Additions prescriptive compliance. Additions shall comply with Sections R502.1.1.1 through R502.1.1.4.

R502.1.1.1 (IRC N1108.1.1.1) Building envelope. New building envelope assemblies that are part of the addition alone shall comply with the prescriptive Sections R402.1, R402.2, R402.3.1 through R402.3.5, and R402.4.1.1, R402.3, and R402.4.1.1.

Exception: Where unconditioned space is changed to conditioned space, the building envelope of the addition shall comply where the Total UA, as determined in Section R402.1.5, of the existing building and the addition, and any alterations that are part of the project, is less than or equal to the Total UA generated for the existing building.

R502.1.1.2 (IRC N1108.1.1.2) Heating and cooling systems. New heating, cooling and duct systems that are part of the addition shall comply with Section R403.

Exception: Where ducts from an existing heating and cooling system are extended to an addition, duct systems with less than 40 linear feet (12.19 m) in unconditioned spaces shall not be required to be tested in accordance with Section R403.3.3.

R502.1.1.3 (IRC N1108.1.1.3) Service hot water systems. New service hot water systems that are part of the addition shall comply with Section R403.4.

R502.1.1.4 (IRC N1108.1.1.4) Lighting. New lighting systems that are part of the addition shall comply with Section R404.1.

Revise as follows:

R502.1.2 (IRC N1108.1.2) Existing plus addition compliance (Simulated Performance Alternative). Cost compliance verification shall demonstrate that the existing building plus the addition does not use more energy than the existing building did prior to the addition. This method requires the project to create cost compliance verification at three stages:

1. A baseline cost compliance of the existing structure prior to construction.
2. Projected cost compliance of the existing building plus the addition based on the proposed design for the building in its entirety.
3. Confirmed cost compliance to verify whole building performance. Where unconditioned space is changed to conditioned space, the addition shall comply where energy use of the addition and the existing building, and any alterations that are part of the project, is less than or equal to the annual energy cost of the existing building when modeled in accordance with Section R405. The addition and any alterations that are part of the project shall comply with Section R405 in its entirety.

Add new text as follows:

R502.1.2.1 (IRC N1108.1.2.1) Reporting. Both the baseline and the projected cost compliance reports that include documentation of the proposed design shall be submitted with the construction documents. A confirmed cost compliance report shall be submitted prior to final inspection.

R502.1.3 (IRC N1108.1.3) Existing plus addition compliance (Energy Rating Index Alternative). An energy rating index score shall demonstrate that the existing building plus the addition does not use more energy than the existing building did prior to the addition. This method requires the project to obtain an ERI score at three stages:

1. A baseline ERI of the existing structure prior to construction.
2. A projected ERI of the existing building plus the addition based on the proposed design for the building in its entirety.
3. A confirmed ERI to verify whole building performance.

R502.1.3.1 (IRC N1108.1.3.1) Reporting. Both the baseline and the projected ERI compliance reports that include documentation for the proposed design shall be submitted with the construction documents. A confirmed ERI report shall be submitted prior to final inspection.

R502.1.4 (IRC N1108.1.4) Existing plus addition compliance (Prescriptive). The existing building plus the addition shall demonstrate that the structure in its entirety does not use more energy than the existing building did prior to adding the addition. All prescriptive measures shall be installed in the addition in accordance Section R402.1. A blower door test shall be performed to establish a baseline air leakage rate for the existing building prior to construction. Prior to final building inspection, a blower door test shall be conducted on the existing building plus addition to demonstrate an air leakage rate equal to or less than the baseline measurement.

R502.1.4.1 (IRC N1108.1.4.1) Reporting. A baseline blower door testing report for the existing building prior to construction shall be submitted with the construction documents. A confirmed blower door testing report shall be submitted after construction is complete and prior to final inspection.

Reason: The current existing buildings chapter 5 of the IECC has always struggled with clearly executing the energy code provisions on additions to an existing building. A building science approach teaches us that the house is a system. Therefore, if an addition is added to an existing building then the system's configuration has changed and assessing compliance on a portion of the system becomes a problem. In reality, it is not possible to assess a portion of the system separated from its entirety for energy code compliance. However, the code has established a method, but not a clear means for trying to do so.

In one form or another the IECC has always stated that an addition shall be deemed to comply where the building with the addition does not used more energy than the existing building did without the addition. The proposal for this section leverages this language (or method) and the existing paths (the means) in the code to offer better compliance mechanisms. The proposed Section R502.1.4 Existing plus addition compliance (Prescriptive), for example, uses a baseline pre-blower door test compared to a final confirmed blower door test to demonstrate if the final product is better than or equal to the existing benchmarked building. The assumption is that the prescriptive R-values, U-values, and installation requirements for the specification installed in the addition will be better than what has been installed in the existing portions of the building. Since it is not practical and, in most cases, possible to perform a blower door on just the addition the requirement changes in order to use the blower door as a compliance mechanism.

A Simulated Performance and Energy Rating Index path have been added as alternative compliance mechanisms in this section of the code for three reasons. First, the blower door is moved back to an assessment of energy performance rather than used as a compliance mechanism. Second, it is our experience that existing portions of a building are almost always touched during the creation of an addition on a building. Therefore, these compliance paths look at the entirety of the building rather than just the addition. Third, design flexibility is achieved when one is not required to use every portion of the prescriptive specification outlined in the code. The clear ability to use tradeoffs in existing buildings fits better with the reality of construction in this arena. Forth, these two pathways enable and encourage pre-planning as well as offer a very clear matrix of compliance. The software analysis to generate the proposed design for the existing building plus the addition clearly projects if the new building in its entirety, will be better than or equal to the existing benchmarked building. The projection enables the designer to forecast what in the existing building must be addressed which helps create better building budgets and expectations. In addition, a variety of options can be presented to pick what in the existing and new sections of the building makes the most sense to address.

Cost Impact: The code change proposal will not increase or decrease the cost of construction

Demonstration of compliance with this code is required regardless, so adding additional options for demonstrating compliance would not add to the cost. It is not a certainty, but added flexibility could reduce the cost of construction as well as jurisdictional time spent on enforcement.

Proposal #: 4747

RE212-19
SECTION R503 (IRC N1109)
ALTERATIONS

R503.1 (IRC N1109.1) General. Alterations to any building or structure shall comply with the requirements of the code for new construction. Alterations shall be such that the existing building or structure is not less conforming to the provisions of this code than the existing building or structure was prior to the alteration. Alterations to an existing building, building system or portion thereof shall conform to the provisions of this code as they relate to new construction without requiring the unaltered portions of the existing building or building system to comply with this code. Alterations shall not create an unsafe or hazardous condition or overload existing building systems. Alterations shall be such that the existing building or structure does not use more energy than the existing building or structure prior to the alteration. Alterations to existing buildings shall comply with Sections R503.1.1 through R503.2.

R503.1.1 (IRC N1109.1.1) Building envelope. Building envelope assemblies that are part of the alteration shall comply with Section R402.1.2 or R402.1.4, Sections R402.2.1 through R402.2.13, R402.3.1, R402.3.2, R402.4.3 and R402.4.5. A pre and post blower door test shall be completed when building thermal envelope alterations are performed. If the alteration results in a post blower door CFM50 measurement that is less that the building airflow standard as set forth in Section R402.4.1.2, then combustion safety testing shall be performed and mechanical ventilation shall be recommended.

Exception: The following alterations shall not be required to comply with the requirements for new construction provided that the energy use of the building is not increased:

1. Storm windows installed over existing fenestration.
2. Existing ceiling, wall or floor cavities exposed during construction provided that these cavities are filled with insulation.
3. Construction where the existing roof, wall or floor cavity is not exposed.
4. Roof re-cover.
5. Roofs without insulation in the cavity and where the sheathing or insulation is exposed during reroofing shall be insulated either above or below the sheathing.
6. Surface-applied window film installed on existing single pane fenestration assemblies to reduce solar heat gain provided that the code does not require the glazing or fenestration assembly to be replaced.

Reason: Alterations to the buildings thermal envelope inevitably impact the air tightness of the building and therefore the combustion safety of the building. This section of the code is in existing buildings which is an indication that the majority of the structures have atmospherically vented appliances. Specifically, atmospherically vented water heaters, which are the most likely appliance to back draft, are susceptible to pressure changes in existing homes. Replacing windows, adding insulation, installing air tight IC rated can lights, or any individual building thermal envelope upgrade, changes the dynamic in the building significantly to warrant preventative combustion safety testing and possibly mechanical ventilation. The proposed language continues to demonstrate the importance of energy codes relationship to health safety and durability as well as efficiency as described in the code’s intent Section R101.3.

Cost Impact: The code change proposal will increase the cost of construction Cost would be impacted as the health and safety of the building to better ensure that the occupant was not poisoned by carbon monoxide would have to be tested. This test cost approximately $200-400 if conducted as a stand-alone test. Many energy retrofit specialists and building envelope specialists include this test as part of their service which brings down the cost.
IECC: R502.1.1.1 (IRC N1108.1.1.1)

Proponent: Shauna Mozingo, City of Westminster, representing Colorado Chapter of ICC Energy Code Development Committee
(smozingo@cityofwestminster.us)

2018 International Energy Conservation Code
Revise as follows:

R502.1.1.1 (IRC N1108.1.1.1) Building envelope. New building envelope assemblies that are part of the addition shall comply with Sections R402.1, R402.2, R402.3.1 through R402.3.5, and R402.4.

Exception: Where unconditioned space is changed to conditioned space, the building envelope of the addition shall comply where the Total UA, as determined in Section R402.1.5, of the existing building and the addition, and any alterations that are part of the project, is less than or equal to the Total UA generated for the existing building.

Reason: This section of the code is talking about additions, which is new construction. The exception is talking about a change in space conditioning, which takes place as an alteration not as new construction. It does not make sense to have this exception for additions.

Cost Impact: The code change proposal will not increase or decrease the cost of construction
The exception wasn't addressing additions to begin with, so there should be no cost to remove it.

Proposal # 5320
RE215-19
IECC: R503.1 (IRC N1109.1)

Proponent: Shaunna Mozingo, City of Westminster, representing Colorado Chapter of ICC Energy Code Development Committee
(smazingo@cityofwestminster.us)

2018 International Energy Conservation Code

Revise as follows:

R503.1 (IRC N1109.1) General. Alterations to any building or structure shall comply with the requirements of the code for new construction, without requiring the unaltered portions of the existing building or building system to comply with this code. Alterations shall be such that the existing building or structure is not less conforming to the provisions of this code than the existing building or structure was prior to the alteration. Alterations to an existing building, building system or portion thereof shall conform to the provisions of this code as they relate to new construction without requiring the unaltered portions of the existing building or building system to comply with this code.

Alterations shall not create an unsafe or hazardous condition or overload existing building systems. Alterations shall be such that the existing building or structure does not use more energy than the existing building or structure prior to the alteration. Alterations to existing buildings shall comply with Sections R503.1.1 through R503.2.

Reason: Removing redundant language.

Cost Impact: The code change proposal will not increase or decrease the cost of construction
Removing redundant language.
2018 International Energy Conservation Code

Revise as follows:

R503.1.1 (IRC N1109.1.1.1) Replacement fenestration. Where some or all of an existing fenestration unit is replaced with a new fenestration product, including sash and glazing, the replacement fenestration unit shall meet the applicable requirements for U-factor and SHGC as specified Table R402.1.2. Where more than one replacement fenestration unit is to be installed, an area-weighted average of the U-factor, SHGC or both of all replacement fenestration units shall be an alternative that can be used to show compliance. Where fenestration was previously used as a trade off in the building thermal envelope, the replacement fenestration shall have a U-Factor and SHGC equal to or less than the original fenestration U-Factor and SHGC.

Reason: If someone used good windows to get out of some insulation or to lower the insulation value and then they go to replace the windows but only used today’s code value there is a chance that they are making the building thermal envelope less conforming than it was at the time of construction. Section 503.1 says that an alteration can never make a structure less conforming or use more energy. This can be easily enforced if a jurisdiction requires the mandatory certificates that are called out in R401.3 that let us know what U-Factors and SHGC went in to the thermal envelope. These certificates become more and more important as we alter our buildings and as we provide trade offs such as window replacements.

Cost Impact: The code change proposal will not increase or decrease the cost of construction. Because the energy code says that you can never make a building less conforming or use more energy, this new wording has always been implied but never written. Therefore, there should be no change in cost.
IECC: R503.1.1 (IRC N1109.1.1)

Proponent: Darren Meyers, P.E., IECC_LLC representing the National Roofing Contractors Association, representing the National Roofing Contractors Association (dmeyers@ieccode.com)

2018 International Energy Conservation Code

Revise as follows:

R503.1.1 (IRC N1109.1.1) Building envelope. Building envelope assemblies that are part of the alteration shall comply with Section R402.1.2 or R402.1.4, Sections R402.2.1 through R402.2.13, R402.3.1, R402.3.2, R402.4.3 and R402.4.5.

Exception: The following alterations shall not be required to comply with the requirements for new construction provided that the energy use of the building is not increased:

1. Storm windows installed over existing fenestration.
2. Existing ceiling, wall or floor cavities exposed during construction provided that these cavities are filled with insulation.
3. Construction where the existing roof, wall or floor cavity is not exposed.
4. Roof re-cover.
5. Roofs without insulation in the cavity and where the sheathing or insulation is exposed during reroofing shall be insulated either above or below the sheathing. Roof replacement, where the required R-value of insulation entirely above the roof deck cannot be provided due to thickness limitations presented by existing rooftop conditions, including an HVAC system or refrigeration equipment, skylight curb(s), low door or glazing heights, weep holes, parapet or roof flashing heights, the maximum approved thickness of insulation compatible with the available space and existing uses shall be installed.
6. Surface-applied window film installed on existing single pane fenestration assemblies to reduce solar heat gain provided that the code does not require the glazing or fenestration assembly to be replaced.

Reason: This proposal is based on CE287-16, and resubmitted for flat-roof residential applications where the required R-value of insulation entirely above the roof deck cannot be provided due to thickness limitations. CE287-16 received a Committee recommendation of “Disapproval,” a Public Comment recommendation of “As Modified by Public Comment” (AMPC), but ultimately did not receive the two-thirds necessary to prevail during the “Online Governmental Consensus Vote” (OGCV), leading to “Disapproval” as its Final Action.

Specifically, the newly proposed exception addresses the AMPC and the challenge of constructability when installing additional roof insulation in reroofing situations including roof recover and roof replacement where existing conditions do not allow for the full thickness of insulation required by Table R402.1.2 or Table R402.1.4. Consider the square footage of residential buildings with flat roofs (i.e., “two-flats” and “three-flats”) constructed before an adoption of the 2009 IECC, that now require reroofing, without adequate “clear space” to accommodate up to 5+ inches (R-25-ish) or 6+ inches (R-30-ish) of insulation as the IECC evolved thru 2012 to 2015 and now the 2018 Editions. The building stock now considered 10 to 20 to 30+ years old, is far more likely to avail itself of skylight and structural curb heights, scupper and sump depths, door and window access thresholds that would turn into ponds, if five to six inches of insulation were "retroactively" foisted upon building ownership.

Moreover, if the IECC CDC were to consult the premise to Section R505.1, that "... [neither] an increase in demand for either fossil fuel [nor] electrical energy shall comply with this code," so long as the current level of insulation in the roof is replaced with an equivalent thickness/level/R-value of NEW insulation product, you’d likely conclude that he newly proposed Exception 5 is a “do-no-harm” proposition.

Should the Committee agree with the newly proposed Exception 5, then the continuance of current Exception 5 is unnecessary, as both the current Exception 4 (Roof re-cover) and the New! Exception 5 (Roof replacement) address all circumstances defined as Reroofing.

We believe the proposal makes clear that the maximum thickness of insulation compatible within the technically-feasible limitations of “available space” and maintaining “positive drainage” is to be installed.

Cost Impact: The code change proposal will not increase or decrease the cost of construction

This change better positions the IECC to be clearer, more easily applied to reroofing, more competitive than the 90.1 Standard alternative on this issue; thereby no cost impact when compared with current provisions.

Proposal # 5271
RE218-19
IECC: R503.1.4

Proponent: Marilyn Williams, representing National Electrical Manufacturers Association (mar_williams@nema.org)

2018 International Energy Conservation Code

Revise as follows:

R503.1.4 (IRC N1109.1.4) Lighting. New lighting systems that are part of the alteration shall comply with Section R404.1.

Exception: Alterations that replace less than 50 percent of the luminaires in a space, provided that such alterations do not increase the installed interior lighting power.

Reason: Revising this language will:
1. Increase energy efficiency
2. Reduce inconsistency and application confusion in compliance
3. Resolve compliance with application, approval and inspection.

This revised language aligns the residential lighting alteration section with the commercial lighting systems Section C503.6. It changes the lighting alteration exception from when less than 50 percent of the luminaires in the space are replaced, to when less than 10 percent are replaced. This will make compliance and usability of the code easier as well as increase in the energy efficiency of alterations when 10 or less than 50 percent of the luminaires are replaced.

Cost Impact: The code change proposal will increase the cost of construction
This code change proposal will increase the cost of construction for residential alterations that replace between 10 and 50 percent of luminaires in a space.
2018 International Energy Conservation Code

Revised as follows:

R503.1.1 (IRC N1109.1.1) Building envelope. Building envelope assemblies that are part of the alteration shall comply with Section R402.1.2 or R402.1.4, Sections R402.2.1 through R402.2.13, R402.3.1, R402.3.2, R402.4.3 and R402.4.5.

Exception: The following alterations shall not be required to comply with the requirements for new construction provided that the energy use of the building is not increased:

1. Storm windows installed over existing fenestration.
2. Existing ceiling, wall or floor cavities exposed during construction provided that these cavities are filled with insulation.
3. Construction where the existing roof, wall or floor cavity is not exposed.
4. Roof re-cover.
5. Roofs without insulation in the cavity entirely above the roof deck and where the sheathing or insulation is exposed during reroofing shall be insulated either above or below the sheathing.
6. Surface-applied window film installed on existing single pane fenestration assemblies to reduce solar heat gain provided that the code does not require the glazing or fenestration assembly to be replaced.

Reason: It is unclear as to the intended application of current Exception 5 to Section 503.1.1. We believe the Exception was intended to apply to low-slope roof reroofing, as defined. However, with all roof re-covers addressed by current Exception 4, it is therefore likely current Exception 5 was intended to apply solely to flat roof replacement operations.

The overall outcome (i.e., fate) in applying Exception 5 to a low-slope roof replacement is seemingly to advise the roofing contractor to install replacement insulation, at whichever thickness and R-value (i.e., recall this is an exception), either above or below the rafter-line.

Cost Impact: The code change proposal will not increase or decrease the cost of construction. There is no cost implication aligned with this proposal. Rather, it is an exercise steeped in clarification and consistency across the ICC Family of International Codes.
RE220-19
IECC: R503.2 (N1109.2), R505.2 (IRC N1111.2)

Proponent: Robby Schwarz, EnergyLogic, representing EnergyLogic (robby@nrglogic.com); Shaunna Mozingo (sdmozingo@shaunnamozingo.com)

2018 International Energy Conservation Code
Revise as follows:

SECTION R503 (IRC N1109)
ALTERATIONS

R503.2 (IRC N1109.2) Change in space conditioning. Any nonconditioned or low-energy space that is altered to become conditioned space shall be required to be brought into full compliance with this code.

Exception: Where the simulated performance option in Section R405 is used to comply with this section, the annual energy cost of the proposed design is permitted to be 110 percent of the annual energy cost otherwise allowed by Section R405.3. Spaces where compliance is demonstrated using the compliance mechanisms in accordance with Section R502.

SECTION R505 (IRC N1111)
CHANGE OF OCCUPANCY OR USE

R505.2 (IRC N1111.2) General. Any space that is converted to a dwelling unit or portion thereof from another use or occupancy shall comply with this code.

Exception: Where the simulated performance option in Section R405 is used to comply with this section, the annual energy cost of the proposed design is permitted to be 110 percent of the annual energy cost allowed by Section R405.3. Spaces where compliance is demonstrated using the compliance mechanisms in accordance with Section R502.

Reason: This proposed change to Alteration and Change of Occupancy or Use in this existing buildings chapter offers a more flexible alternative compliance paths as outlined in the proposal for prescriptive, simulated performance, and energy rating index compliance paths in the Additions section of Section R505 Existing Buildings Performance Compliance Alternative. If the proposal is not accepted this proposal will be removed from consideration.

Cost Impact: The code change proposal will not increase or decrease the cost of construction. Demonstration of compliance with this code is required regardless, so adding additional options for demonstrating compliance would not add to the cost. It is not a certainty, but added flexibility could reduce the cost of construction as well as jurisdictional time spent on enforcement.

Proposal # 4751
IECC: R505.1 (IRC N1107.1), R505.2 (IRC N1111.2)

Proponent: Shaunna Mozingo, representing Self (smozingo@cityofwestminster.us)

2018 International Energy Conservation Code

Revise as follows:

R505.1 (IRC N1107.1) General. Spaces undergoing a change in occupancy that would result in an increase in demand for either fossil fuel or electrical energy shall comply with this code, Section 501.1.1.

R505.2 (IRC N1111.2) General. Any space that is converted to a dwelling unit or portion thereof from another use or occupancy shall comply with this code, Section 501.1.1.

Exception: Where the simulated performance option in Section R405 is used to comply with this section, the annual energy cost of the proposed design is permitted to be 110 percent of the annual energy cost allowed by Section R405.3.

Reason: Sections R502.1 and R503.1 reference complying with the code for new construction without requiring unaltered portions of the building to “comply with this code”. Section R503.2 requires the space to be brought in to “full compliance with this code”. Section 505.1 and 505.2 say a space has to “comply with this code”. What is all that saying?

Many building departments read all of them to say the same thing that you have to be brought in to full compliance with the code. But if you look at the scope of both of these sections, they all have a different intent. It’s pretty clear that when dealing with additions and alterations you only have to fix what you touch. And it stands to reason in 503.2 that if you go from a building that didn’t use energy to a building that does use energy you need to comply with the entire code. But when you get to a change of occupancy or use, the intent becomes less clear. It says you have to comply with the code but does that mean “full code” like stated in 503.2 or “this code” like stated in 502 and 503?

Because 505 is dealing with a space that has already been conditioned (or you would be in 503.2) and its dealing with a change, we feel that the intent is truly that these spaces must comply with the code as it relates to existing buildings. Therefore, we have removed the confusing language and inserted the section that tells you which sections of the code your existing building must comply with.

For those who interpreted this existing section to require all changes of occupancy or use to be brought in to full compliance they are not going to like allowing unaltered portions to not be brought in to full compliance. But, we would say it never had to be or the wording in 503.2 would have been carried over to 505. It is our intent that when changing an occupancy or use that increases the demand for either fossil fuel or electrical energy you only have to change what the appropriate sections require you to change.

Changes in space conditioning are so different than changes of use. There’s a big difference between a building that never complied versus a building that complied when it was built and is now changing its use. If you require every change of use to be brought in to 100% compliance you are discouraging the re-use of existing buildings. It becomes cheaper to move in to a new building than to get the best we can out of an existing building and move on.

Cost Impact: The code change proposal will decrease the cost of construction

Complying with only specific sections referenced in Chapter 5 instead of the entire code will likely decrease the cost of construction.

Proposal # 5332

RE221-19
RE222-19

IECC: RA103.1 (IRC AT103.1), RA103.5 (IRC AT103.5) (New), RA103.6 (IRC AT103.6)(New)

Proponent: Shauna Mozingo, City of Westminster, representing Colorado Chapter of ICC Energy Code Development Committee (smozingo@cityofwestminster.us)

2018 International Energy Conservation Code

Revise as follows:

RA103.1 (IRC AT103.1) General. New detached one- and two-family dwellings, and townhouses with not less than 600 square feet (55.74 m²) of roof area oriented between 110 degrees and 270 degrees of true north shall comply with Sections RA103.2 through RA103.8.

Exceptions:

1. New residential buildings with a permanently installed on-site renewable energy system.
2. A building with a solar-ready zone that is shaded where all areas of the roof that would otherwise meet the requirements of Section RA103 are in full or partial shade for more than 70 percent of daylight hours annually.

RA103.4 (IRC AT103.4) Obstructions. Solar-ready zones shall be free from obstructions, including but not limited to vents, chimneys, and roof-mounted equipment.

Add new text as follows:

RA103.5 (IRC AT103.5) Shading. The solar-ready zone shall be set back from any existing or new, permanently affixed object on the building or site that is located south, east or west of the solar zone a distance not less than 2 times the object’s height above the nearest point on the roof surface. Such objects include, but are not limited to, taller portions of the building itself, parapets, chimneys, antennas, signage, roof top equipment, trees and roof plantings.

RA103.6 (IRC AT103.6) Capped Roof Penetration Sleeve. A capped roof penetration sleeve shall be provided adjacent to a solar-ready zone located on a roof slope of not greater than 1 unit vertical in 12 units horizontal (8-percent slope). The capped roof penetration sleeve shall be sized to accommodate the future photovoltaic system conduit, but shall have an inside diameter of not less than 1 1/4 inches (32 mm).

Reason: The solar ready appendix in the IRC was changed last cycle but the changes were not incorporated in the solar ready appendix of IECC residential provisions. It was our understanding that anything dealing with residential provisions of the energy code would automatically match what was in the IRC, but apparently this does not apply to the appendix chapters. There is absolutely no reason that these two appendix chapters should differ.

Cost Impact: The code change proposal will increase the cost of construction. The cost of a roof penetration sleeve would be incurred if you were building to the IECC and had not been using the IRC. This would perhaps happen for multi family buildings less than 3 stories in height or for jurisdictions who use the IECC residential provisions and not the IRC.

Proposal # 5338
Appendix RB (IRC Appendix Q)  
ZERO ENERGY RESIDENTIAL BUILDING PROVISIONS

RB102 (IRC AQ 102) COMPLIANCE  (Note: language to replace R401.2 Compliance)
Existing residential buildings shall comply with Chapter 5. New residential buildings shall comply with Section RB103.

RB103 (IRC AQ 103)
ZERO ENERGY RESIDENTIAL BUILDINGS

RB103.1 (IRC AQ103.1) General. New residential buildings shall comply with Section RB103.

RB103.2 (IRC AQ103.2) Energy Rating Index Zero Energy Score. Compliance with this section requires that the rated design be shown to have a score less than or equal to the values in Table RB103.2 when compared to the ERI reference design determined in accordance with RESNET/ICC 301 for each of the following:
1. ERI value not including net onsite power production calculated in accordance with RESNET/ICC 301, and
2. ERI value including net onsite power production calculated in accordance with RESNET/ICC 301

<table>
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<th>CLIMATE ZONE</th>
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<th>ENERGY RATING INDEX including onsite power (as proposed)</th>
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</tbody>
</table>

a. The building shall meet the mandatory requirements of Section R406.2, and the building thermal envelope shall be greater than or equal to the levels of efficiency and SHGC in Table R402.1.2 or Table R402.1.4. of the 2015 International Energy Conservation Code.

Reason: This proposal provides cities and states an appendix to the residential section of the 2021 IECC that would result in a residential building that has zero energy consumption over the course of a year. Jurisdictions would have the prerogative to adopt the appendix in support of policy goals related to energy efficiency and renewable energy.

The provisions contained in this appendix are not mandatory unless specified as such in the jurisdiction's adopting ordinance.

Why is this needed?

States and cities across the country are pursuing policies to reduce the energy consumption of buildings. More than 270 cities and counties and 10 states are signatories to the "We Are Still In" commitment supporting climate action to meet the goals of the Paris climate accord. Thus far, seventy cities have committed to being powered by 100% renewable energy and more are joining all the time. The building energy code is an important policy tool for jurisdictions as they pursue these types of policy goals.

Many of these energy and climate-related goals have a target year of 2030, so the time is ripe to provide this option in the model energy code. While jurisdictions already can modify the model code to meet their needs, many do not have the in-house expertise to develop and vet this type of code language. Integrating a zero energy building pathway into the 2021 IECC as a jurisdictional option will make the model energy code a more robust policy tool. Use of appendices in the IECC have proven successful with the solar provisions in the 2018 IECC appendices.
Including a zero energy building appendix in the model energy code can smooth the transition to zero energy for builders. Rather than jurisdictions going alone—leading to a patchwork of zero energy residential code approaches—a single IECC appendix would provide consistent national language across the residential industry for manufacturers, builders and trades. Builders can standardize their construction practices across jurisdictions and states to meet these requirements. This makes education, incentive programs, and implementation significantly more straightforward and cost-effective.

How the Zero Energy appendix works

While there are a number of definitions of “zero energy buildings” (also referred to as “zero net energy,” “net zero energy,” or simply, “net zero”), the Appendix is based on the Energy Rating Index (ERI) compliance path found in section R406 of the 2018 IECC. In principle, the proposal works as follows:

1. Required ERI values are based on a highly efficient energy use performance level before considering on-site power generation.

2. The remaining energy use, on an annual level, is satisfied with on-site power generation.

The Energy Rating Index scores are set for a highly efficient level of energy consumption, which importantly, is still cost effective for the homeowner. These scores, which range from 42 to 48 based on climate zone, were calculated based on a thorough analysis of HERS scores nationwide, a survey of HERS scores for model high-performance home, modeling done for ASHRAE 90.2, and the U.S. DOE Zero Energy Ready Home program.

On-site renewable energy capacity is then required to meet the remaining energy use, resulting in an Energy Rating Index score of zero. Software required in the RESNET 301 standard can easily generate an ERI score of the home before and after the inclusion of renewable energy (known as Onsite Power Production in HERS). All renewable energy is required to be on-site. The minimum envelope backstops required in section R406 are also required in this appendix. Homes may use any fuel in accordance with RESNET 301 to comply with the Appendix.


Cost Impact: The code change proposal will increase the cost of construction
If adopted by the state or jurisdiction, complying with this appendix will increase the first cost of construction but the Energy Rating Index values, before the addition of onsite power production, that have been selected were found to be cost effective based on information presented to the ASHRAE Standard 90.2 committee. All of the ERI scores without onsite power production have been found to have Savings/Investment Ratios (SIR) of greater than 1.0.

Proposal # 5205

RE223-19
2018 International Energy Conservation Code

Add new text as follows:

Appendix RB
STRETCH ENERGY CODE PROVISIONS

SECTION RB101
GENERAL

RB101.1 Scope. The provisions of this appendix shall be applicable for new construction or portions of existing residential buildings undergoing renovation or addition where increased levels of energy efficiency are required.

SECTION RB102
REQUIREMENTS

RB102.1 Requirements. Residential buildings or portions of residential buildings shall meet the requirements of ASHRAE/IES Standard 90.2.

SECTION RB103
REFERENCE STANDARDS

Add new standard(s) as follows:

ASHRAE


Proposal # 5284
Appendix U
STRETCH ENERGY CODE PROVISIONS

SECTION AU101
GENERAL

AU101.1 Scope. The provisions of this appendix shall be applicable for new construction or portions of existing residential buildings undergoing renovation or addition where increased levels of energy efficiency are required.

Revise as follows:

SECTION AU102
REQUIREMENTS

AU102.1 Requirements. Residential buildings or portions of residential buildings shall meet the requirements of ASHRAE/IES Standard 90.2.

SECTION AU103
REFERENCE STANDARDS

Add new standard(s) as follows:

ASHRAE


Reason: Some jurisdictions are interested in adopting stretch energy codes. Providing a stretch code through the reference of ANSI/ASHRAE/IES Standard 90.2-2018 allows for a stretch code that is based on an ERI methodology that is compatible with the ERI pathway within the base IECC. The ERI levels specified within 90.2-2018 have been specified as Tier 3 within the CEE New Residential Construction Specification, while the IECC 2018 ERI path is specified as Tier 1. (https://library.cee1.org/content/cee-residential-new-construction-specification/)

Cost Impact: The code change proposal will increase the cost of construction
The cost of construction will increase in the jurisdictions which adopt the stretch code appendix, but Standard 90.2 has been analyzed to be cost effective. The cost effectiveness analysis is reported in FSEC-RR-584-15 Maximum Energy Efficiency Cost Effectiveness in New Home Construction, dated May 20, 2015 (available at http://www.fsec.ucf.edu/en/publications/pdf/FSEC-RR-584-15.pdf).

Staff Analysis: A review of the standard proposed for inclusion in the code, ASHRAE 90.2-2018, with regard to the ICC criteria for referenced standards (Section 3.6 of CP#28) will be posted on the ICC website on or before April 2, 2019.
RE225-19
IECC: R403.2 (IRC N1103.2)

Proponent: Donald Sivigny, representing State of MN and Association of Minnesota Building Officials (don.sivigny@state.mn.us)

2018 International Energy Conservation Code

R403.2 (IRC N1103.2) Hot water boiler outdoor temperature setback. Hot water boilers that supply heat to the building through one- or two-pipe heating systems shall have an outdoor setback control that decreases the boiler water temperature based on the outdoor temperature.

Exception: Boiler systems also used for domestic water heating.

Reason: This proposal is a correlation to the IECC-C code proposal to provides clarity to the requirements. Why is the proposed code change a reasonable solution? It clarifies an exception.

Cost Impact: The code change proposal will decrease the cost of construction
This code change exempts domestic water heating from adding these setback controls which costs money to install (and maintain). By not installing them on the domestic water heating system it will save on costs of equipment.