

IECC - Commercial



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

April 28 - May 8, 2019
Albuquerque Convention
Center, Albuquerque, NM

2018-2019 Code Development Cycle, Group B (2019) Proposed Changes to the 2019 *International Codes*

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2019 GROUP B – PROPOSED CHANGES TO THE INTERNATIONAL ENERGY CONSERVATION CODE

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TENTATIVE ORDER OF DISCUSSION 2019 PROPOSED CHANGES TO THE INTERNATIONAL ENERGY CONSERVATION CODE - COMMERCIAL

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 CE code change proposals may not be included on this list, as they are being heard by another committee.

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CE1-19 Part I

PART I — IECC: Part I: SECTION C101.2, C101.3, C101.4.1, C101.5, C202, C202, (New), C401.1, C401.2, C401.2.1(New),

IECC: Part II R101.2, R101.3(N1101.2) , R101.4.1, R101.5, R202 (N1101.6), R202 (N1101.6) (New), R401, R401.2.1(N1101.13.1)(New), R401.2.2(N1101.13.2)(New), R401.3(N1101.14)

PART II — IECC: R101.2, R101.3 (IRC N1101.2), R101.4.1, R101.5, R202 (IRC N1101.6), R401.1, R401.2 (IRC N1101.13), R401.2.1 (IRC 1101.13.1) (New), R401.2.1 (IRC N1101.13.1, R401.3 (IRC N1101.14)

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

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

2018 International Energy Conservation Code

SECTION C101 SCOPE AND GENERAL REQUIREMENTS

C101.1 Title. This code shall be known as the Energy Conservation Code of [NAME OF JURISDICTION], and shall be cited as such. It is referred to herein as “this code.”

Revise as follows:

C101.2 Scope. This code applies to *commercial buildings* and ~~the buildings' sites and associated systems and equipment; structures , their associated sites , systems and equipment; and energy-using systems and equipment associated with sites~~ considered areas of land under the control of a single owner or entity.

C101.3 Intent. This code shall regulate the design and construction of *buildings , structures and sites* for the effective use and conservation of energy over ~~the their~~ useful life ~~of each building~~. This code is intended to provide flexibility to permit the use of innovative approaches and techniques to achieve this objective. This code is not intended to abridge safety, health or environmental requirements contained in other applicable codes or ordinances.

C101.4.1 Mixed residential and commercial buildings, structures and sites. Where a *building, structure or site* includes both *residential building uses* and *commercial building portions uses*, each ~~portion use group~~ shall be separately considered and meet the applicable provisions of IECC—Commercial Provisions or IECC—Residential Provisions.

C101.5 Compliance. *Residential buildings, structures and sites* shall meet the provisions of IECC—Residential Provisions. *Commercial buildings, structures and sites* shall meet the provisions of IECC—Commercial Provisions.

SECTION C202 GENERAL DEFINITIONS

~~BUILDING SITE.~~ A contiguous area of land that is under the ownership or control of one owner or entity.

Add new definition as follows:

[A] STRUCTURE. That which is built or constructed.

SECTION C401 GENERAL

Revise as follows:

C401.1 Scope. The provisions in this chapter are applicable to commercial *buildings, structures* and ~~their building-sites~~.

C401.2 Application. *Commercial buildings, structures, and sites* shall comply with one of the following:

1. The requirements of ANSI/ASHRAE/IESNA 90.1.
2. The requirements of Sections C402 through C405 and C408. In addition, *commercial buildings, associated structures and sites* shall comply with Section C406 and tenant spaces shall comply with Section C406.1.1.
3. The requirements of Sections C402.5, C403.2, C403.3 through C403.3.2, C403.4 through C403.4.2.3, C403.5.5, C403.7, C403.8.1 through C403.8.4, C403.10.1 through C403.10.3, C403.11, C403.12, C404, C405, C407 and C408. The aggregate building, structure and site energy cost shall be equal to or less than 85 percent of the standard reference design building.

Add new text as follows:

C401.2.1 Application to structures and sites. Energy-using systems and equipment serving sites or structures, with or without a contiguous building, including site lighting; motors for pumps, fountain pumps and water moving equipment; and vertical transportation equipment, elevators and escalators, shall meet the applicable provisions of this code as described in Sections C403, C404, C405, C407 and C408

Proposal # 5602

CE1-19 Part I

CE1-19 Part II

IECC: R101.2, R101.3 (IRC N1101.2), R101.4.1, R101.5, R202 (IRC N1101.6), R401.1, R401.2 (IRC N1101.13), R401.2.1 (IRC 1101.13.1) (New), R401.2.1 (IRC N1101.13.1, R401.3 (IRC N1101.14)

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

2018 International Energy Conservation Code

Revise as follows:

SECTION R101 (IRC N1101) SCOPE AND GENERAL REQUIREMENTS

R101.1 Title. This code shall be known as the Energy Conservation Code of [NAME OF JURISDICTION], and shall be cited as such. It is referred to herein as “this code.”

R101.2 Scope. This code applies to *residential buildings* and ~~the building sites and associated systems and equipment.~~ structures, their associated *sites*, ~~systems and equipment;~~ and energy-using systems and equipment associated with sites considered areas of land under the control of a single owner or entity.

R101.3 (IRC N1101.2) Intent. This code shall regulate the design and construction of *buildings, structures and sites* for the effective use and conservation of energy over the their useful life ~~of each building.~~ This code is intended to provide flexibility to permit the use of innovative approaches and techniques to achieve this objective. This code is not intended to abridge safety, health or environmental requirements contained in other applicable codes or ordinances.

R101.4.1 Mixed residential and commercial buildings, structures and sites. Where a *building, structure or site* includes both *residential building uses* and *commercial building portions uses*, each ~~portion use group~~ shall be separately considered and meet the applicable provisions of the IECC—Commercial Provisions or IECC—Residential Provisions.

R101.5 Compliance. *Residential buildings, structures and sites* shall meet the provisions of IECC—Residential Provisions. *Commercial buildings, structures and sites* shall meet the provisions of IECC—Commercial Provisions.

SECTION R202 (IRC N1101.6) GENERAL DEFINITIONS

~~BUILDING SITE.~~ A ~~contiguous~~ contiguous area of land that is under the ownership or control of one owner or entity.

Add new text as follows:

STRUCTURE. That which is built or constructed.

Revise as follows:

SECTION R401 GENERAL

R401.1 Scope. This chapter applies to *residential buildings*, structures and sites.

R401.2 (IRC N1101.13) Compliance. Projects Buildings , structures and sites 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.

Add new text as follows:

R401.2.1 (IRC N1101.13.1) Application to structures and sites. Energy-using systems and equipment serving sites or structures , with or without a contiguous residential building , including site lighting; motors for pumps, fountain pumps and water moving equipment; and vertical transportation equipment, lifts, elevators and escalators, shall meet the applicable provisions of this code as described in Sections R403, R404, R405 and R406.

Revise as follows:

~~R401.2.1~~ **R401.2.2 (IRC N1101.13.2) Tropical zone.** Residential buildings, structures and sites 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 unvented.
7. Roof surfaces have a slope of not less than one-fourth 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.

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, at the structure , or in a conspicuous location on site. 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.

Reason: There are areas outside of residential buildings where energy savings is possible by applying provisions currently in the IECC. Examples include lighting in parking lots that may or may not be directly associated with a commercial or residential building or lighting and equipment associated with a physical plant or pump, public or private parks a public or private campus or planned-unit-development. Imagine the additional and credible energy savings that could be acquired by expanding the scope and applicaiton of the residential provisions of the IECC, as such.

This proposal expands the scope and application of the residential provisions of the IECC to apply to energy-using systems in areas outside of the building structure itself. The proposal revises an existing term "BUILDING SITE" and introduces term, "STRUCTURE" utilized throughout the ICC Family of *International Codes*, to define those types of environments where the building may not enclose the extent of energy-using lighting, motor, pumping and vertical transportation systems and equipment addressed in the code as currently constituted. Also, a new provision is included in Chapter 4 [RE] "Application" to address structures and sites with or without buildings.

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

While there will be a cost impact associated with this change when compared to current provisions, the change better positions the IECC to be clearer, more easily applied to structures and sites constructed without associated buildings, and more competitive than the 90.1 Standard or the Standard 90.2 alternatives on the issues.

Proposal # 5626

CE1-19 Part II

CE2-19

IECC: Section C101.3

Proponent: Sharon Bonesteel, Salt River Project, representing Salt River Project (sharon.bonesteel@srpnet.com); Steven Rosenstock, representing Edison Electric Institute (srosenstock@eei.org)

2018 International Energy Conservation Code

Revise as follows:

C101.3 Intent. This code shall regulate the design and construction of buildings for the effective use and conservation of energy over the useful life of each building. The shift of a load from on-peak period to off-peak shall be considered a part of the effective use of energy. This code is intended to provide flexibility to permit the use of innovative approaches and techniques to achieve this objective. This code is not intended to abridge safety, health or environmental requirements contained in other applicable codes or ordinances.

Reason: The conservation of energy and its related cost are the foundation of the IECC. Since the cost of energy is time dependent, it makes sense to include the shift of a load from *on-peak* (most expensive per kw) to *off peak* (least expensive) as a part of the effective use of energy. The definitions for *load*, *on-peak* and *off peak* are included in another code change proposal. Those proposed definitions are as follows:

- **LOAD** A portion of a system that consumes electric energy. The total electrical *load* of a building is the sum of all electricity consuming appliances, lights and systems, necessary for a building to function as designed.
- **ON-PEAK** The time of use during which the cost per kiloWatt-hour (kWh) is the highest and when the maximum generation resources are required to supply electricity to the customer.
- **OFF-PEAK** The time of use during which the cost per kiloWatt-hour (kWh) is the lowest and when generation resources are being underutilized.

The terms are found defined in on-line sources. These could be added to the proposal, if needed, at public comment stage.

Cost Impact: The code change proposal will not increase or decrease the cost of construction. This code change clarifies that load shifting is a part of the efficient use of energy and does not increase or decrease the cost of construction.

Proposal # 5002

CE2-19

CE3-19 Part I

PART I — IECC: Part I: C101.3

IECC: Part II: R101.3(N1101.2)

PART II — IECC: R101.3 (IRC N1101.2)

Proponent: Joseph H. Cain, Solar Energy Industries Association (SEIA), representing Solar Energy Industries Association (SEIA) (JoeCainPE@gmail.com)

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

2018 International Energy Conservation Code

Revise as follows:

C101.3 Intent. This code shall regulate the design and construction of buildings and systems for the effective use and conservation of energy over the useful life of each building, including effective integration of energy efficiency measures, renewable energy systems, and energy storage systems. This code is intended to provide flexibility to permit the use of innovative approaches and techniques, including innovative approaches and techniques ~~to achieve this objective; that achieve the most cost-effective means of compliance.~~ This code is not intended to abridge safety, health or environmental requirements contained in other applicable codes or ordinances.

Proposal # 5487

CE3-19 Part I

CE3-19 Part II

IECC: R101.3 (IRC N1101.2)

Proponent: Joseph H. Cain, Solar Energy Industries Association (SEIA), representing Solar Energy Industries Association (SEIA) (JoeCainPE@gmail.com)

2018 International Energy Conservation Code

Revise as follows:

R101.3 (IRC N1101.2) Intent. This code shall regulate the design and construction of *buildings and systems* for the effective use and conservation of energy over the useful life of each building, including effective integration of energy efficiency measures, renewable energy systems, and energy storage systems. This code is intended to provide flexibility to permit the use of innovative approaches and techniques, including innovative approaches and techniques ~~to achieve this objective.~~ that achieve the most cost-effective means of compliance. This code is not intended to abridge safety, health or environmental requirements contained in other applicable codes or ordinances.

Reason: Renewable energy systems are an important component of the IECC, but the Intent section is presently silent on them. 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.

As grid penetration of renewable energy systems increases, the need to energy storage systems -- mostly battery storage -- also increases. The Intent section of the IECC should evolve with our societal needs, as by the time this edition is in effect there will be even more renewable energy systems and battery storage systems.

Renewable energy is already explicitly included in the IECC in multiple locations, including, but not limited to: Section C202 Definitions; Section C407.3 Performance-based compliance; Appendix CA Solar Ready Zone; Section R406 Energy Rating Index; Appendix RA Solar Ready Provisions. The Intent section needs to catch up with the provisions within the code.

Cost Impact: The code change proposal will not increase or decrease the cost of construction. This proposal represents a forward-thinking clarification of intent only, with no increase or decrease in cost of construction.

Proposal # 5695

CE3-19 Part II

CE4-19 Part I

PART I — IECC: Part I: Section C101.3

IECC: Part II: Section R101.3(N1101.2)

PART II — IECC: R101.3 (IRC N1101.2)

Proponent: William McHugh, The McHugh Company, representing Chicago Roofing Contractors Association
(billmchugh-jr@att.net)

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

2018 International Energy Conservation Code

Revise as follows:

C101.3 Intent. This code shall regulate the design and construction of buildings for the ~~effective-use and conservation~~ of energy over the useful life of each building. This code is intended to provide flexibility to permit the use of innovative approaches and techniques to achieve this objective. This code is not intended to abridge safety, health or environmental requirements contained in other applicable codes or ordinances.

Proposal # 5330

CE4-19 Part I

CE4-19 Part II

IECC: R101.3 (IRC N1101.2)

Proponent: William McHugh, The McHugh Company, representing Chicago Roofing Contractors Association (billmchugh-jr@att.net)

2018 International Energy Conservation Code

R101.3 (IRC N1101.2) Intent. This code shall regulate the design and construction of *buildings* for the ~~effective use and conservation~~ of energy over the useful life of each building. This code is intended to provide flexibility to permit the use of innovative approaches and techniques to achieve this objective. This code is not intended to abridge safety, health or environmental requirements contained in other applicable codes or ordinances.

Reason: The International Energy Conservation Code should regulate the minimum energy use requirements for a building throughout its life cycle. The IECC's Intent Section goes beyond minimum requirements and sets an unenforceable tone of 'effective use' and 'conservation of energy'. While these are noble goals, codes are to regulate minimum requirements. This proposal brings the section in line with the statements in the section above intent:

"The code is intended to be adopted as a legally enforceable document and it cannot be effective without adequate provisions for its administration and enforcement."

Adding words 'effective use' and 'conservation of energy', is not legally enforceable, confusing and brings opinion into the intent of the code. The intent sections should state that the code consists of minimum technical requirements as stated in the Energy Code sections - the 'provisions'. This proposal clarifies that the code is the minimum requirements, which is very clearly, legally enforceable.

Cost Impact: The code change proposal will not increase or decrease the cost of construction. This proposal is neutral when it comes to costs as it clarifies language and purpose of the code.

Proposal # 5758

CE4-19 Part II

CE5-19 Part I

PART I — IECC: Part I: Section C101.3

IECC: Part II: Section R101.3(N1101.2)

PART II — IECC: R101.3 (IRC N1101.2)

Proponent: Hope Medina, representing Self (hmedina@coloradocode.net)

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PART II WILL BE HEARD BY THE IECC-RESIDENTIAL COMMITTEE. SEE THE TENTATIVE HEARING ORDER
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2018 International Energy Conservation Code

Revise as follows:

C101.3 Intent. This code shall regulate the design and construction of buildings for life safety along with the effective use and conservation of energy over the useful life of each building. This code is intended to provide flexibility to permit the use of innovative approaches and techniques to achieve this objective. This code is not intended to abridge safety, health or environmental requirements contained in other applicable codes or ordinances.

Proposal # 5470

CE5-19 Part I

CE5-19 Part II

IECC: R101.3 (IRC N1101.2)

Proponent: Hope Medina, representing Self (hmedina@coloradocode.net)

2018 International Energy Conservation Code

Revise as follows:

R101.3 (IRC N1101.2) Intent. This code shall regulate the design and construction of *buildings* for life safety along with the effective use and conservation of energy over the useful life of each building. This code is intended to provide flexibility to permit the use of innovative approaches and techniques to achieve this objective. This code is not intended to abridge safety, health or environmental requirements contained in other applicable codes or ordinances.

Reason: There is a misconception among some end users that the energy code is not a life safety code and this is not correct. The energy code either independently or working in conjunction with the other codes assist with several aspects of what is considered the main stream life safety. It assists with tight construction for fire, moisture diffusion within assemblies, and usability during extreme conditions. The intent should identify that this code is promoting life safety as it is stated in the other I-codes.

Cost Impact: The code change proposal will not increase or decrease the cost of construction
This change just acknowledges the life safety contribution.

Proposal # 5468

CE5-19 Part II

CE6-19 Part I

PART I — IECC: Part I: Section C101.3

IECC: Part II: Section R101.3(N1101.2)

PART II — IECC: R101.3 (IRC N1101.2)

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

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

2018 International Energy Conservation Code

Revise as follows:

C101.3 Intent. This code shall regulate the design and construction of buildings for the effective use and conservation of energy primarily for human comfort over the useful life of each building. This code is intended to provide flexibility to permit the use of innovative approaches and techniques to achieve this objective. This code is not intended to abridge safety, health or environmental requirements contained in other applicable codes or ordinances.

Proposal # 5400

CE6-19 Part I

CE6-19 Part II

IECC: R101.3 (IRC N1101.2)

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

2018 International Energy Conservation Code

Revise as follows:

R101.3 (IRC N1101.2) Intent. This code shall regulate the design and construction of *buildings* for the effective use and conservation of energy primarily for human comfort over the useful life of each building. This code is intended to provide flexibility to permit the use of innovative approaches and techniques to achieve this objective. This code is not intended to abridge safety, health or environmental requirements contained in other applicable codes or ordinances.

Reason: Indeed, it remains the intent of the IECC to apply to energy using systems designed primarily for human occupancy (i.e., thermal comfort, visual comfort and service hot-water comfort), and -- unless specifically noted to otherwise -- does not apply to energy using systems designed for commercial, business, educational or industrial processes. This interpretation of the IECC, the Code Council has offered in the past remains the same.

While there remain some direct and indirect inferences to commercial, business, educational or industrial process energy uses throughout the IECC, there exist no "explicit" or "all-inclusive" delineations as to energy end uses designed primarily for humans to live, sleep, eat, work, and play in and around residential buildings and residential building sites. Some examples of the direct and indirect inferences to commercial, business, educational or industrial process energy uses, include:

1. C402.1.1 Greenhouses.
2. C402.1.2 [*telecommunications*] Equipment buildings.
3. C403.5 Economizers (Prescriptive), Exception 2; "... spaces designed to be humidified above 35°F (1.7°C) dewpoint temperature to satisfy "process needs."
4. C403.5.4.1 Design capacity; for:
 - "Systems primarily serving computer rooms ...",
 - "Systems where dehumidification requirements cannot be met using outdoor air temperatures of 50°F (10°C)
 - dry bulb/45°F (7°C) wet bulb
 - and where 100 percent of the expected system cooling load at 45°F (7°C) dry bulb/40°F (4°C) wet bulb is met with evaporative water economizers."
5. C403.7.1 Demand control ventilation (Mandatory), Exception 5; Ventilation provided only for "process loads."
6. C403.10.1 or C403.10.2 for Walk-in coolers, walk-in freezers, refrigerated warehouse coolers and refrigerated warehouse freezers.
7. C405.3.1 Total connected interior lighting power, Several exemptions:

- Lighting for photographic processes,
- Lighting for plant growth,
- Lighting for food warming, and
- Lighting in demonstration equipment for education,

8. C405.4.1 Total connected exterior lighting power, Several exemptions:

- Lighting associated with transportation,
- Temporary lighting, Industrial production, material handling and transportation lighting, and
- Theme element lighting in theme parks.

9. C406.7.1 Load fraction, Exception 2; "Waste heat recovery from ... building equipment, or process equipment."

10. C407.1 Scope; with reference to: "... receptacle loads and process loads," and energy used to recharge or refuel vehicles used for on-road and off-site transportation purposes.

Therefore, as was the case with the 2003 IECC, it is our opinion that neither the 2006 IECC nor its 2009, 2012, 2015, 2018 or forthcoming 2021 editions are intended to require greenhouses (heated/cooled primarily to preserve the commodity - plants) to meet the envelope provisions of the code.

Section 101.3 the 2006 IECC (our opinion) was inadvertently truncated by the Department of Energy in an effort to improve the utility and enforceability of the IECC vis-a-vis a 'MONSTROUS' scoping and technical content change (see EC48-03/04).

So then, without the proposed language, and interpreted literally, the IECC could indeed be read as limiting the amount of energy put into a blast furnace at a foundry, energy dedicated to civilian booster pumping stations and wastewater treatment facilities keeping our civilian water supply clean, energy to operate fermenting casks at a distillery, energy to run a conveyor at a packaging plant, or even the energy to modulate cabinet temperatures within telecommunication shelters dedicated to switching and signal receiving. However, this is simply not pragmatic and not the case.

Bibliography: A copy of p.1 from the 2003 ICC International Energy Conservation Code.

SECTION 101 GENERAL

101.1 Title. These regulations shall be known as the *Energy Conservation Code* of [NAME OF JURISDICTION], and shall be cited as such. It is referred to herein as "this code."

101.2 Scope. This code establishes minimum prescriptive and performance-related regulations for the design of energy-efficient buildings and structures or portions thereof that provide facilities or shelter for public assembly, educational, business, mercantile, institutional, storage and residential occupancies, as well as those portions of factory and industrial occupancies designed primarily for human occupancy. This code thereby addresses the design of energy-efficient building envelopes and the selection and installation of energy-efficient mechanical, service water-heating, electrical distribution and illumination systems and equipment for the effective use of energy in these buildings and structures.

Exception: Energy conservation systems and components in existing buildings undergoing repair, alteration or additions, and change of occupancy, shall be permitted to comply with the *International Existing Building Code*.

101.2.1 Exempt buildings. Buildings and structures indicated in Sections 101.2.1.1 and 101.2.1.2 shall be exempt from the building envelope provisions of this code, but shall comply with the provisions for building, mechanical, service water heating and lighting systems.

101.2.1.1 Separated buildings. Buildings and structures, or portions thereof separated by building envelope assemblies from the remainder of the building, that have a peak design rate of energy usage less than 3.4 Btu/h per square foot (10.7 W/m²) or 1.0 watt per square foot (10.7 W/m²) of floor area for space conditioning purposes.

101.2.1.2 Unconditioned buildings. Buildings and structures or portions thereof which are neither heated nor cooled.

101.2.2 Applicability. The provisions of this code shall apply to all matters affecting or relating to structures and premises, as set forth in Section 101. Where, in a specific case, different sections of this code specify different materials, methods of construction or other requirements, the most restrictive shall govern.

[EB] 101.2.2.1 Existing installations. Except as otherwise provided for in this chapter, a provision in this code shall not require the removal, alteration or abandonment of, nor prevent the continued utilization and maintenance of, an existing building envelope, mechanical, service water-heating, electrical distribution or illumination system lawfully in existence at the time of the adoption of this code.

[EB] 101.2.2.2 Additions, alterations or repairs. Additions, alterations, renovations or repairs to a building en-

velope, mechanical, service water-heating, electrical distribution or illumination system or portion thereof shall conform to the provisions of this code as they relate to new construction without requiring the unaltered portion(s) of the existing system to comply with all of the requirements of this code. Additions, alterations or repairs shall not cause any one of the aforementioned and existing systems to become unsafe, hazardous or overloaded.

[EB] 101.2.2.3 Historic buildings. The provisions of this code relating to the construction, alteration, repair, enlargement, restoration, relocation or movement of buildings or structures shall not be mandatory for existing buildings or structures specifically identified and classified as historically significant by the state or local jurisdiction, listed in *The National Register of Historic Places* or which have been determined to be eligible for such listing.

[EB] 101.2.2.4 Change in occupancy. It shall be unlawful to make a change in the occupancy of any building or structure which would result in an increase in demand for either fossil fuel or electrical energy supply unless such building or structure is made to comply with the requirements of this code or otherwise approved by the authority having jurisdiction. The code official shall certify that such building or structure meets the intent of the provisions of law governing building construction for the proposed new occupancy and that such change of occupancy does not result in any increase in demand for either fossil fuel or electrical energy supply or any hazard to the public health, safety or welfare.

101.2.3 Mixed occupancy. When a building houses more than one occupancy, each portion of the building shall conform to the requirements for the occupancy housed there. Where minor accessory uses do not occupy more than 10 percent of the area of any floor of a building, the major occupancy shall be considered the building occupancy. Buildings other than detached one- and two-family dwellings and townhouses, with a height of four or more stories above grade shall be considered commercial buildings for the purposes of this code, regardless of the number of floors that are classified as residential occupancy.

101.3 Intent. The provisions of this code shall regulate the design of building envelopes for adequate thermal resistance and low air leakage and the design and selection of mechanical, electrical, service water-heating and illumination systems and equipment which will enable effective use of energy in new building construction. It is intended that these provisions provide flexibility to permit the use of innovative approaches and techniques to achieve effective utilization of energy. This code is not intended to abridge safety, health or environmental requirements under other applicable codes or ordinances.

2003 INTERNATIONAL ENERGY CONSERVATION CODE®

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 of the IECC Purpose and Scope. The resulting exclusions would mean the process energies assigned to domestic water pressure booster and sprinkler system pumping stations, wastewater treatment facilities, greenhouses

and telecommunication shelters on residential property would be "excluded" from the scope and applicability of the IECC, without the need for explicitly articulated lists or exceptions. No change to stringency is proposed.

Proposal # 5637

CE6-19 Part II

CE7-19 Part I

PART I — IECC: Part I: Section C101.3

IECC: Part II: Section R101.3(IRC N1101.2)

PART II — IECC: R101.3 (IRC N1101.2)

Proponent: Steven Rosenstock, Edison Electric Institute, representing Edison Electric Institute
(srosenstock@eei.org)

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

2018 International Energy Conservation Code

Revise as follows:

C101.3 Intent. This code shall regulate the design and construction of buildings for the effective use, conservation, production, and conservation-storage of energy over the useful life of each building. This code is intended to provide flexibility to permit the use of innovative approaches and techniques to achieve this objective. This code is not intended to abridge safety, health or environmental requirements contained in other applicable codes or ordinances.

Proposal # 4692

CE7-19 Part I

CE7-19 Part II

IECC: R101.3 (IRC N1101.2)

Proponent: Steven Rosenstock, representing Edison Electric Institute (srosenstock@eei.org)

2018 International Energy Conservation Code

Revise as follows:

R101.3 (IRC N1101.2) Intent. This code shall regulate the design and construction of *buildings* for the effective use , conservation, production, and conservation storage of energy over the useful life of each building. This code is intended to provide flexibility to permit the use of innovative approaches and techniques to achieve this objective. This code is not intended to abridge safety, health or environmental requirements contained in other applicable codes or ordinances.

Reason: This proposal updates the intent to show that the IECC is now starting to regulate energy production and energy storage systems that are installed in new homes. This update is needed to account for trends in certain areas of the US.

For example, Appendix RB contains requirements for solar-ready provisions installed on single-family homes and townhouses. In Section 406, the Energy Rating Index Compliance Alternative, renewable energy production can be used to obtain a better score. Therefore, the code is now starting to regulate renewable energy production systems that are installed in residential facilities.

Renewable energy systems are a form of energy production, not building energy use. The production of renewable energy does not conserve the amount of energy a building or end-use system or appliance will use. The intent of the code should be updated to account for the recent code changes.

In addition, in California's Title 24, PV energy production systems are now required on new homes (with some exceptions). One of the options with this mandate is to include an on-site energy storage system in the home, as shown below:

From CA Title 24-2019:

"PV sizes from Equation 150.1-C may be reduced by 25 percent if installed in conjunction with a battery storage system. The battery storage system shall meet the qualification requirements specified in Joint Appendix JA12 and have a minimum capacity of 7.5 kWh."

Therefore, code officials will be enforcing the installation of on-site renewable energy production systems, along with the installation of on-site energy storage systems in some cases. This will in addition to enforcing the energy conservation requirements of the energy code.

Bibliography: California Energy Commission, "*2019 BUILDING ENERGY EFFICIENCY STANDARDS FOR RESIDENTIAL AND NONRESIDENTIAL BUILDINGS*", December 2018
<https://www.energy.ca.gov/2018publications/CEC-400-2018-020/CEC-400-2018-020-CMF.pdf>

Cost Impact: The code change proposal will not increase or decrease the cost of construction. In this proposal, the requirements in the code are not being changed. This proposal only clarifies the intent of the energy code to account for what is already occurring in certain building energy codes.

Proposal # 4691

CE8-19 Part I

PART I — IECC: Part I: Section C102.1

IECC: Part II: Section R102.1

PART II — IECC: R102.1

Proponent: Daniel Bresette, Alliance to Save Energy, representing Alliance to Save Energy
(dbresette@ase.org)

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

2018 International Energy Conservation Code

Revise as follows:

C102.1 General. The provisions of this code are not intended to prevent the installation of any material or to prohibit any design or method of construction not specifically prescribed by this code, provided that any such alternative has been *approved*. An alternative material, design or method of construction shall be *approved* where the *code official* finds that the proposed design is satisfactory and complies with the intent of the provisions of this code, and that the material, method or work offered is, for the purpose intended, not less than the equivalent of that prescribed in this code in quality, strength, effectiveness, *fire resistance*, durability and safety. Where the alternative material, design or method of construction is not *approved*, the *code official* shall respond in writing, stating the reasons why the alternative was not *approved*. The requirements identified as "mandatory" in Chapter 4 shall be met.

Proposal # 5266

CE8-19 Part I

CE8-19 Part II

IECC: R102.1

Proponent: Daniel Bresette, Alliance to Save Energy, representing Alliance to Save Energy
(dbresette@ase.org)

2018 International Energy Conservation Code

Revise as follows:

R102.1 General. The provisions of this code are not intended to prevent the installation of any material or to prohibit any design or method of construction not specifically prescribed by this code. The *code official* shall have the authority to approve an alternative material, design or method of construction upon application of the owner or the owner's authorized agent. The code official shall first find that the proposed design is satisfactory and complies with the intent of the provisions of this code, and that the material, method or work offered is, for the purpose intended, not less than the equivalent of that prescribed in this code for strength, effectiveness, fire resistance, durability and safety. Where the alternative material, design or method of construction is not *approved*, the *code official* shall respond to the applicant, in writing, stating the reasons why the alternative was not *approved*. The requirements identified as "mandatory" in Chapter 4 shall be met.

Reason: The purpose of this code change proposal is to help ensure that critical energy conservation measures are included in every new home, irrespective of the compliance path selected. Although Section R102.1.1/C102.1.1 of the IECC already requires that all above-code programs meet the "mandatory" measures of the code, there is currently no specific language that requires alternative materials, designs or methods of construction (in R102.1/C102.1) meet these important requirements. We believe that these alternative methods (for which there is very little direction provided in the code) should at a minimum require compliance with "mandatory" measures. Without such a requirement, we are concerned that this section could serve as a massive loophole for any code user that does not want to comply with one of the mandatory provisions.

Cost Impact: The code change proposal will not increase or decrease the cost of construction. The mandatory measures are already required by the code.

Staff Analysis: There is not a coordinate section in Chapter 11 of the IRC.

Proposal # 4017

CE8-19 Part II

CE9-19 Part I

PART I — IECC: Part I: Section C102.1

IECC: Part II: Section R102.1

PART II — IECC: R102.1

Proponent: William Fay, Energy-Efficient Codes Coalition, representing Energy-Efficient Codes Coalition (bfay@ase.org)

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

2018 International Energy Conservation Code

Revise as follows:

C102.1 General. The provisions of this code are not intended to prevent the installation of any material or to prohibit any design or method of construction not specifically prescribed by this code, provided that any such alternative has been *approved*. An alternative material, design or method of construction shall be *approved* where the *code official* finds that the proposed design is satisfactory and complies with the intent of the provisions of this code, and that the material, method or work offered is, for the purpose intended, not less than the equivalent of that prescribed in this code in quality, strength, effectiveness, *fire resistance*, durability, energy conservation and safety. Where the alternative material, design or method of construction is not *approved*, the *code official* shall respond in writing, stating the reasons why the alternative was not *approved*.

Proposal # 5267

CE9-19 Part I

CE9-19 Part II

IECC: R102.1

Proponent: William Fay, Energy-Efficient Codes Coalition, representing Energy-Efficient Codes Coalition (bfay@ase.org)

2018 International Energy Conservation Code

Revise as follows:

R102.1 General. The provisions of this code are not intended to prevent the installation of any material or to prohibit any design or method of construction not specifically prescribed by this code. The *code official* shall have the authority to approve an alternative material, design or method of construction upon application of the owner or the owner's authorized agent. The code official shall first find that the proposed design is satisfactory and complies with the intent of the provisions of this code, and that the material, method or work offered is, for the purpose intended, not less than the equivalent of that prescribed in this code for strength, effectiveness, fire resistance, durability, energy conservation and safety. Where the alternative material, design or method of construction is not *approved*, the *code official* shall respond to the applicant, in writing, stating the reasons why the alternative was not *approved*.

Reason: The purpose of this code change proposal is to help ensure that energy conservation will be considered in any request for approval of alternative materials, designs, or methods of construction. Although the current language of Section R102.1/C102.1 requires alternatives to be "not less than the equivalent" of the code requirement for quality, strength, effectiveness, fire resistance, durability, and safety, it is important that the energy conservation impact be considered as well – particularly in the International Energy Conservation Code.

Cost Impact: The code change proposal will not increase or decrease the cost of construction. The proposal merely clarifies that energy conservation must be considered in assessing alternatives to IECC requirements.

Staff Analysis: There is not a coordinate section in IRC Chapter 11, however IRC Section R104.11 covers the subject matter.

Proposal # 4018

CE9-19 Part II

CE10-19 Part I

PART I — IECC: Part I: Section C102.1

IECC: Part II: Section R102.1

PART II — IECC: R102.1

Proponent: Maureen Guttman, BCAP-IBTS, representing BCAP-IBTS (mguttman@bcapcodes.org)

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

2018 International Energy Conservation Code

Revise as follows:

C102.1 General. The provisions of this code are not intended to prevent the installation of any material or to prohibit any design or method of construction not specifically prescribed by this code, provided that any such alternative has been *approved*. ~~An~~ The code official shall have the authority to approve an alternative material, design or method of construction shall be approved where the code official finds upon the written application of the owner or the owner's authorized agent. The code official shall first find that the proposed design is satisfactory and complies with the intent of the provisions of this code, and that the material, method or work offered is, for the purpose intended, not less than the equivalent of that prescribed in this code in quality, strength, effectiveness, fire resistance, durability and safety. Where the alternative material, design or method of construction is not approved, the The code official shall respond to the applicant, in writing, stating the reasons why the alternative was approved or was not approved.

Proposal # 5264

CE10-19 Part I

CE10-19 Part II

IECC: R102.1

Proponent: Maureen Guttman, BCAP-IBTS, representing BCAP-IBTS (mguttman@bcapcodes.org)

2018 International Energy Conservation Code

Revise as follows:

R102.1 General. The provisions of this code are not intended to prevent the installation of any material or to prohibit any design or method of construction not specifically prescribed by this code, provided that any such alternative has been *approved*. The *code official* shall have the authority to approve an alternative material, design or method of construction upon the written application of the owner or the owner's authorized agent. The code official shall first find that the proposed design is satisfactory and complies with the intent of the provisions of this code, and that the material, method or work offered is, for the purpose intended, not less than the equivalent of that prescribed in this code for strength, effectiveness, fire resistance, durability and safety. ~~Where the alternative material, design or method of construction is not *approved*, the~~ The *code official* shall respond to the applicant, in writing, stating the reasons why the alternative was *approved* or was not *approved*.

Reason: The purpose of this code change proposal is to bring more consistency and transparency in code enforcement by helping to ensure that requests for recognition of alternative materials, designs, or methods of construction, and responses to these requests, be put in writing. This proposal does not change any substantive requirements of the code, but creates a record of the process for seeking alternatives to code requirements. The current code language already requires a written response in cases when a request is not approved, but does not specify what the code official should do when an alternative is approved. We do not believe that requiring a request and a response to be written in both cases will be onerous – in fact, we believe that many building code officials already require this.

This proposal also synchronizes the language in the residential and commercial chapters. In the 2018 IECC, the language of C102.1 and R102.1 were updated, but with some differences between the two. We have proposed adopting the language from each section that provides the most clarity for code users.

Cost Impact: The code change proposal will not increase or decrease the cost of construction. These changes do not modify any code requirements.

Staff Analysis: There is not a coordinate section in IRC Chapter 11, however IRC Section R104.11 covers the subject matter.

Proposal # 4016

CE10-19 Part II

CE11-19 Part I

PART I — IECC: Part I: Section C102.1.1

IECC: Part II: Section R102.1.1(N1101.4)

PART II — IECC: R102.1.1 (IRC N1101.4)

Proponent: Shaunna Mazingo, City of Westminster, representing Self (smozingo@cityofwestminster.us)

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

2018 International Energy Conservation Code

Revise as follows:

C102.1.1 ~~Above code~~ Alternate Energy Efficiency 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.

Proposal # 5434

CE11-19 Part I

CE11-19 Part II

IECC: R102.1.1 (IRC N1101.4)

Proponent: Shaunna Mozingo, City of Westminster, representing Self (smozingo@cityofwestminster.us)

2018 International Energy Conservation Code

Revise as follows:

R102.1.1 (IRC N1101.4) ~~Above code~~ Alternate Energy Efficiency 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.

Reason: This section references national, state or local energy efficiency programs so the title should reflect that. It tells you in the wording that the program must exceed the code, it doesnt have to say it in the title as well.

Cost Impact: The code change proposal will not increase or decrease the cost of construction
simple title change, no cost involved.

Proposal # 5694

CE11-19 Part II

CE12-19 Part I

PART I — IECC: Part I: Section C102.1.1, Chapter 6CE

IECC: Part II: Section R102.1.1(N1101.4)

PART II — IECC: R102.1.1 (IRC N1101.4)

Proponent: Harry Misuriello, American Council for an Energy-Efficient Economy, representing American Council for an Energy-Efficient Economy (misuriello@verizon.net)

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

2018 International Energy Conservation Code

Revise as follows:

C102.1.1 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 where such buildings meet the requirements identified as “mandatory” in Chapter 4 ~~shall be met, and~~ and the *building thermal envelope* is greater than or equal to levels of efficiency and *Solar Heat Gain Coefficients* in Table 502.3 and either Table 502.1.2 or 502.2(1) of the 2009 *International Energy Conservation Code* .

Add new text as follows:

ICC

International Code Council, Inc.
500 New Jersey Avenue NW 6th
Floor
Washington DC 20001

IECC-2009: International Energy Conservation Code

Proposal # 5504

CE12-19 Part I

CE12-19 Part II

IECC: R102.1.1 (IRC N1101.4)

Proponent: 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:

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 where such buildings also meet the requirements identified as “mandatory” in Chapter 4 ~~shall be met~~ and the building thermal envelope is 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.

Reason: The purpose of this code change proposal is to establish a reasonable level of efficiency for the permanent thermal envelope in buildings constructed to “above code” programs. The IECC already requires that buildings constructed to the standards of an above-code program demonstrate compliance with the “mandatory” measures of the IECC; this proposal applies a minimum thermal envelope backstop similar to the one that applies to the Energy Rating Index in Section R406. If a minimum backstop is necessary for the ERI, it stands to reason that a minimum backstop would be even more valuable in an even less fully defined and potentially less rigorous “above code” program.

We have proposed the 2009 IECC in this proposal to maintain consistency with the current section R406, but we would also support referencing the 2012 IECC. (We have proposed updating the Section R406 backstop to the 2012 IECC in a separate proposal because we believe that as the IECC improves in efficiency, so also should the backstops and consumer protection provisions of the code.)

Cost Impact: The code change proposal will not increase or decrease the cost of construction. Because the 2018 IECC is the baseline for any above-code program (and any cost impact statement), and because this backstop is far less stringent than the base code requirements, we do not expect any added construction costs as a result.

Proposal # 4019

CE12-19 Part II

CE13-19 Part I

PART I — IECC: Part I: C103.2
IECC: Part II: R103.2 (N1101.5)

PART II — IECC: R103.2 (IRC N1101.5)

Proponent: Hope Medina, representing Self (hmedina@coloradocode.net)

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

2018 International Energy Conservation Code

Revise as follows:

C103.2 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, but are not limited to, the following as applicable:

1. Energy compliance path
2. Insulation materials and their *R*-values.
3. Fenestration *U*-factors and solar heat gain coefficients (SHGCs).
4. Area-weighted *U*-factor and solar heat gain coefficient (SHGC) calculations.
5. Mechanical system design criteria.
6. Mechanical and service water heating systems and equipment types, sizes and efficiencies.
7. Economizer description.
8. Equipment and system controls.
9. Fan motor horsepower (hp) and controls.
10. Duct sealing, duct and pipe insulation and location.
11. Lighting fixture schedule with wattage and control narrative.
12. Location of *daylight* zones on floor plans.
13. Air sealing details.

Proposal # 5674

CE13-19 Part I

CE13-19 Part II

IECC: R103.2 (IRC N1101.5)

Proponent: Hope Medina, representing Self (hmedina@coloradocode.net)

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

Reason: The plan examiner needs to know what energy compliance path the project was designed to, so they are able to determine if the project demonstrates compliance with the specific energy requirements. Often this information is not provided on the construction documents, and plans examiners are required to investigate which add time to the review process. This extension may be in the form of a review comment, or the time it takes to retrieve the information by email or phone. Providing this information at submittal will allow the plans examiner to review the plans to the intended energy compliance path the architect/designer chose for the project.

Cost Impact: The code change proposal will not increase or decrease the cost of construction. The reason it will not increase the cost is because essentially the architect or designer is just declaring which energy compliance path they chose for the project. It is usually a few words placed on the plans i.e. Prescriptive path or Performance path.

Proposal # 5669

CE13-19 Part II

CE14-19

IECC: C103.2

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:

C103.2 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, but are not limited to, the following as applicable:

1. Insulation materials and their *R*-values.
2. Fenestration *U*-factors and solar heat gain coefficients (SHGCs).
3. Area-weighted *U*-factor and solar heat gain coefficient (SHGC) calculations.
4. Mechanical system design criteria.
5. Mechanical and service water heating systems and equipment types, sizes and efficiencies.
6. Economizer description.
7. Equipment and system controls.
8. Fan motor horsepower (hp) and controls.
9. Duct sealing, duct and pipe insulation and location.
10. Lighting fixture schedule with wattage and control narrative.
11. Location of *daylight* zones on floor plans.
12. Air sealing details.
13. Heating and cooling load values for all systems, including documentation of heating and cooling load calculations, such as clear notation of the software or methodology used and key inputs and outputs for all zones, or the 25 largest capacity zones where a project has more than 25 zones.
14. Fan motor brake horsepower (bhp) required for fan motors 1 hp and larger
15. Provisions for HVAC system commissioning and balancing.
16. Provisions for functional testing of lighting controls.

17. Others items as determined by the code official

Reason: 1. Why is the proposed code change needed?

A. Additional information is required in the 2018 IECC section C103.2 that is important for the ability of code officials to complete a proper review of plans. It is important to know and understand how the building is going to be built at time of permit application. Building it, and then submitting as built documents make absolutely no sense if you want the building to perform correctly and actually save energy. We would not build things such as automobiles, pacemakers and other things, without knowing ahead of time, exactly how to build them and how they interact with other components, so why do we think we should be able to do that with buildings. We need to do it right and have all the building information available ahead of time before the permit is issued.

B. The current list's omission of two other specific construction document requirements, in the 2018 IECC, makes it likely that these will often be overlooked. These requirements are in section C408.2 Mechanical systems, and service water-heating systems commissioning and completion requirements, and section C403.8.2 Motor nameplate horsepower.

C. There are currently no other construction document requirements that will allow a plan reviewer to verify that the requirements of the following sections are met: C403.1.1 Calculation of heating and cooling loads, C403.3.1 Equipment sizing, and C408.3 Functional testing of lighting controls will be met.

d. All of the above items are needed and should be required to be submitted at time of plan review in order for the Code official to be able to do a proper plan review for a building that will perform in compliance with the code.

1. Why is the proposed code change a reasonable solution?

The only requirement that will require more than a very modest amount of additional design team effort is for heating and cooling load sizing, and its' documentation (item 5 in the list). These calculations are already required by code, so this just adds a requirement that a listing of results and documentation be provided. The amount of effort is kept reasonable for large buildings by limiting the documentation to the largest 25 zones for buildings with more than 25 zones.

Cost Impact: The code change proposal will not increase or decrease the cost of construction. There is not cost that will be associated with this code change. 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 it the specs it will need to be built and inspected to.

Proposal # 5068

CE14-19

CE15-19 Part I

PART I — IECC: Part I: C103.2.2(New)

IECC: Part II: R103.2 (N1101.5.2.2)(New)

PART II — IECC: R103.2.2 (IRC N1101.5.2.2) (New)

Proponent: Hope Medina, representing Self (hmedina@coloradocode.net)

2018 International Energy Conservation Code

Add new text as follows:

C103.2.2 Energy reference construction documents The requirements in this code shall be represented on the construction documents and specifically identification as energy reference sheets. Each trade has the option to locate their specific requirements within their section of the construction documents.

Proposal # 5473

CE15-19 Part I

CE15-19 Part II

IECC: R103.2.2 (IRC N1101.5.2.2) (New)

Proponent: Hope Medina, representing Self (hmedina@coloradocode.net)

2018 International Energy Conservation Code

Add new text as follows:

R103.2.2 (IRC N1101.5.2.2) Energy reference construction documents The requirements in this code shall be represented on the construction documents and specifically identification as energy reference sheets. Each trade has the option to locate their specific requirements within their section of the construction documents.

Reason: The concept represented in this proposal is not a new concept. Construction plans will place the accessibility requirements and/or fire rated construction requirements on their own sheets with references to them throughout the construction plans. The intent of this proposal is similar to this concept. The intent of this proposal is to assist with gaining compliance with the requirements within this code. Often the requirements are placed intermittently throughout the plans and notes, which are then often inadvertently missed by plans examiners, builders, contractors, and inspectors because of the inconsistent locations they are placed. When placing all of the energy requirements within the construction plans on one or more sheets as needed will allow for the end users to be able to apply the energy requirements the architect, designers, and engineers have designed the project to. The proposal acknowledges that each trade may need to provide their respective energy requirements within their own section of the construction plans, but each trade is still required to provide the information on their sheets.

When everything is placed in one location it becomes easier to verify that all the requirements have been identified. When located in many places throughout the plans often plans examiners will write a review comment that will require the architect/designer to locate it on the plans, write a response to the comments, and take up valuable time for both the architect/designer and plans examiner. This may eliminate the needless review comments because one cannot find the information on the plans, and reduce the time needed to respond by the architect/designer. The idea is to reduce the time needed to get the project through the permitting process. This will allow for those involved with the construction process to install the energy requirements as designed and allow the inspector to inspect for them.

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

This proposal may increase the cost of construction on the front end with possible additional construction sheets. It may decrease the time in the permitting process which should decrease the cost of construction. It may also decrease the cost of construction for the builders when they are able to comply with the energy requirements and how the project was designed to by decreasing the number of reinspection. Which will also assist with the construction schedule.

Proposal # 5485

CE15-19 Part II

CE16-19 Part I

PART I — IECC Part I: C105.4, C105.4.1(New), C105.4.2(New), C105.4.3(New)

IECC Part II: R105.4, R105.4.1(New), R105.4.2(New), R105.4.3(New)

PART II — IECC: R105.4, R105.4.1 (New), R105.4.2 (New), R105.4.3 (New)

Proponent: Robby Schwarz, EnergyLogic, representing EnergyLogic (robby@nrglogic.com); Shaunna Mozingo, representing self (sdmozingo@shaunnamozingo.com)

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

2018 International Energy Conservation Code

SECTION C105 INSPECTIONS

Revise as follows:

C105.4 Approved third-party inspection agencies. The *code official* is authorized to accept reports of third-party inspection agencies not affiliated with the building design or construction, provided that such agencies are *approved* as to qualifications and reliability relevant to the building components and systems that they are inspecting.

Add new text as follows:

C105.4.1 Authorization of approved third-party inspection agency. When the code official authorizes the use of a third-party inspection agency for all or some aspects of code compliance inspections, the agency shall be authorized as a third-party extension of the code official to verify compliance.

C105.4.2 Approved third-party inspections agreement. The third-party inspection agency and the code official shall agree upon which compliance verification measures will be incorporated within each of their inspection processes. These measures shall include mandatory or other provisions required by the specific path of compliance chosen from C401.2.

C105.4.3 Approved third-party inspections reporting. The approved agency shall submit inspection reports to the code official and to the owner's representative in accordance with Section 1704.2.4 of the *International Building Code*.

Proposal # 5268

CE16-19 Part I

CE16-19 Part II

IECC: R105.4, R105.4.1 (New), R105.4.2 (New), R105.4.3 (New)

Proponent: Robby Schwarz, EnergyLogic, representing EnergyLogic (robby@nrglogic.com); Shaunna Mozingo (sdmozingo@shaunnamozingo.com)

2018 International Energy Conservation Code

SECTION R105 INSPECTIONS

Revise as follows:

R105.4 Approved third-party inspection agencies. The *code official* is authorized to accept reports of third-party inspection agencies not affiliated with the *building* design or construction, provided that such agencies are *approved* as to qualifications and reliability relevant to the *building* components and systems that they are inspecting.

Add new text as follows:

R105.4.1 Authorization of approved third- party inspection agency. When the code official authorizes the use of a third-party inspection agency for all or some aspects of code compliance inspections, the agency shall be authorized as a third-party extension of the code official to verify compliance.

R105.4.2 Approved third-party inspections agreement. The third-party inspection agency and the code official shall agree upon which compliance verification measures will be incorporated within each of their inspection processes. These measures shall include mandatory or other provisions required by the specific path of compliance chosen from R401.2.

R105.4.3 Approved third-party inspections reporting. The approved agency shall submit inspection reports to the code official and to the owner's representative in accordance with Section 1704.2.4 of the *International Building Code*.

Reason: In relation to the International Energy Conservation Code, third-party inspection agencies and building officials currently have a variety of ideas regarding what should constitute the work of the agency. For the ERI path, for example, many Raters understand that they must develop an ERI score, but do not fully understand their relationship to inspection of the mandatory requirements of the IECC. Jurisdictions having authority, are often either abdicating inspections or believe that Rater's are looking at mandatory inspection items. In addition, the creation of a HERS Index score is different from the creation of an ERI score. A HERS Index score is an asset rating which allows for the derating of the R-value of poorly installed insulation in the energy model, as the objective is to benchmark the energy performance of the home on the HERS Index scale. An IECC ERI evaluation of the installation of Insulation does not allow for the deration of poorly installed insulation. If insulation is not installed in accordance with the manufactures instruction and the guidance given in table R402.4.1.1, then the installation should fail inspection and be reinstalled until it meets the mandatory requirement of the code. This disconnect in understanding is the genesis of this code change proposal. Building on the charging language of the approved inspection agency this proposal makes it clear that the inspection agency is third party. This proposal states that when acting as a third party the agency is actually acting as an extension of the jurisdiction having full delegated authority in order to better ensure there is no confusion between the project owner and their construction representatives on site. The most important part of this proposed language is the requirement to create a scope of work that defines the relationship between the third-party inspection agency and the authority having jurisdiction. Ultimately neither identity can rely on

assumptions, and this proposal requires a level of coordination and dialog that is not overly burdensome yet extremely important.

As with the outlined special inspections of the IBC, the proposal ends by demonstrating to the project owner and their representative that defined inspection must occur either through the authority having jurisdiction or the approved third-party inspection agency and that the construction schedule can not proceed with subsequent phases of construction until all sequential inspections take place and pass. Lastly, the proposal seeks documentation that all approved inspections occurred and meet the intent of the code.

The clarity gained in the relationship between the authority having jurisdiction and the approved third-party inspection agency is crucial as we progress into more complicated and meaningful energy codes. Nationally, jurisdictions are losing experienced professionals to retirement. Consequently, more third-party inspection agencies are stepping in to fill the gap. These third-party inspection agencies tend to be solely focused on energy and are capable, and eager to work in the energy code compliance niche. They are filling a need for jurisdictions that are either under staffed or lack a desire to fully enforce the energy components of the code. This proposal clearly defines a path forward to meet the need by defining scope and responsibilities to better ensure compliance and thus achieve expected energy savings.

Cost Impact: The code change proposal will not increase or decrease the cost of construction. This proposal does not increase cost but better allocates dollars currently being spent to ensure that the job being undertaken by approved third party inspection agencies truly meets the needs of the authority having jurisdiction.

Staff Analysis: There is not a coordinate section for R105.4 in Chapter 11 of the IRC.

Proposal # 5797

CE16-19 Part II

CE17-19 Part I

PART I — IECC: Part I: C107.1.2

IECC: Part II: R107.1.2

IRC: Part III: R102.4.2

PART II — IECC: R107.1.2

PART III — IRC®: R102.4.2

Proponent: Craig Drumheller, National Association of Home Builders, representing National Association of Home Builders (CDrumheller@nahb.org)

THIS IS A 3 PART CODE CHANGE. PART I WILL BE HEARD BY THE IECC- COMMERCIAL COMMITTEE. PART II WILL BE HEARD BY THE IECC-RESIDENTIAL COMMITTEE. PART III WILL BE HEARD BY THE IRC BUILDING COMMITTEE. SEE THE TENTATIVE HEARING ORDER FOR THESE COMMITTEES.

2018 International Energy Conservation Code

Revise as follows:

C107.1.2 Provisions in referenced codes and standards. Where the extent of the reference to a referenced code or standard includes subject matter that is within the scope of this code, the provisions of this code, as applicable, shall take precedence over the provisions in the referenced code or standard. Compliance materials, as cited in Section C101.5.1, shall incorporate the provisions of this code instead of the provisions in the referenced code or standard. Where proof of compliance is embedded in materials such as software, an affidavit attesting that software or other materials comply with this section shall be available..

Proposal # 5314

CE17-19 Part I

CE17-19 Part II

IECC: R107.1.2

Proponent: Craig Drumheller, National Association of Home Builders, representing National Association of Home Builders (CDrumheller@nahb.org)

2018 International Energy Conservation Code

Revise as follows:

R107.1.2 Provisions in referenced codes and standards. Where the extent of the reference to a referenced code or standard includes subject matter that is within the scope of this code, the provisions of this code, as applicable, shall take precedence over the provisions in the referenced code or standard. Compliance materials, as cited in Section R101.5.1, shall incorporate the provisions of this code instead of the provisions in the referenced code or standard. Where proof of compliance is embedded in materials such as software, an affidavit attesting that software or other materials comply with this section shall be available..

Proposal # 5749

CE17-19 Part II

CE17-19 Part III

IRC®: R102.4.2

Proponent: Craig Drumheller, National Association of Home Builders, representing National Association of Home Builders (CDrumheller@nahb.org)

2018 International Residential Code

R102.4.2 Provisions in referenced codes and standards. Where the extent of the reference to a referenced code or standard includes subject matter that is within the scope of this code, the provisions of this code, as applicable, shall take precedence over the provisions in the referenced code or standard. Compliance materials, as cited in Section N1101.3, shall incorporate the provisions of this code instead of the provisions in the referenced code or standard. Where proof of compliance is embedded in materials such as software, an affidavit attesting that software or other materials comply with this section shall be available..

Reason: There are supporting materials provided by third party developers which are referenced in the IECC. Often, these materials don't clearly state that they are fully compliant with the requirements of the code. This language change provides the AHJ the clear authority to ask for a written statement from the developer of the materials that they attest their product is compliant with the requirements of this code.

Cost Impact: The code change proposal will not increase or decrease the cost of construction
This code change proposal may raise the cost for supporting materials that were non-compliant.

Proposal # 5750

CE17-19 Part III

CE18-19 Part I

PART I — IECC: Part I: C202(New)

IECC: Part II: R202 (N1101.6)(New)

PART II — IECC: R202 (IRC N1101.6)

Proponent: Hope Medina, representing Self (hmedina@coloradocode.net)

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

2018 International Energy Conservation Code

SECTION C202 GENERAL DEFINITIONS

Add new definition as follows:

ACCESSORY STRUCTURE. A structure that is accessory to and incidental to that of the building and that is located on the same lot.

Proposal # 5510

CE18-19 Part I

CE18-19 Part II

IECC: R202 (IRC N1101.6)

Proponent: Hope Medina, representing Self (hmedina@coloradocode.net)

2018 International Energy Conservation Code

SECTION R202 (IRC N1101.6) GENERAL DEFINITIONS

Add new definition as follows:

ACCESSORY STRUCTURE. A structure that is incidental to that of the dwelling and that is located on the same lot.

Reason: The scope of this code states accessory structures are to comply with the requirements but does not provide a definition for what would be considered an accessory structure. This is similar to what is found in the International Residential Code.

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

Staff Analysis: The purpose of providing definitions in I-codes is to define terms used in that specific I-code. The term “accessory structure” is not used in the IECC.

Proposal # 5508

CE18-19 Part II

CE19-19 Part I

PART I — IECC: Part I: C202(New)

IECC: Part II: R202 (N1101.6); Chapter 6RE(New)

PART II — IECC: R202 (IRC N1101.6), ASTM Chapter 6

Proponent: Donald Sivigny, State of Minnesota, 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- COMMERCIAL COMMITTEE. PART II WILL BE HEARD BY THE IECC-RESIDENTIAL COMMITTEE. SEE THE TENTATIVE HEARING ORDER FOR THESE COMMITTEES.

2018 International Energy Conservation Code

SECTION C202 GENERAL DEFINITIONS

Add new definition as follows:

AIR-IMPERMEABLE INSULATION. An Insulation that functions as an air barrier material having an air permeance equal to or less than $0.02\text{L/s} = \text{m}^2$ at 75 Pa pressure differential as tested in accordance with ASTM E2178 or E283.

Proposal # 5365

CE19-19 Part I

CE19-19 Part II

IECC: R202 (IRC N1101.6), ASTM Chapter 6

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

2018 International Energy Conservation Code

SECTION R202 (IRC N1101.6) GENERAL DEFINITIONS

Revise as follows:

AIR-IMPERMEABLE INSULATION. An Insulation that functions as an air barrier material having an air permeance equal to or less than $0.02\text{L/s} = \text{m}^2$ at 75 Pa pressure differential as tested in accordance with ASTM E2178 or E283.

ASTM

ASTM International
100 Barr Harbor Drive, P.O. Box
C700
West Conshohocken, PA 19428-
2959

Add new standard(s) as follows:

ASTM E2178-13 Standard Test Method for Air Permanence of Building Materials

Reason: This change combines and utilizes the language of the IRC and IECC definitions together for consistency, and accuracy as to what air impermeable insulation must meet to reduce both, air infiltration and exfiltration. This definition will create better enforcement and understanding of the code by providing a test standard. Because the definition in Section IRC Section N1101.6 is incomplete, this revision will allow the IRC Chapter 2 definition to cover Chapter 11 uses of the term. This will avoid confusion for both the builder and the code official.

If this proposal is successful, there will be no need to have a special definition just for Chapter 11. The definition can therefore be removed from Section N1101.6 to avoid duplication in the same document, and reduce confusion and document size and cost.

Cost Impact: The code change proposal will not increase or decrease the cost of construction. This proposal simply adds the already required standard for air impermeable to the definitions of air impermeable insulation. There is not going to be any added costs or savings for clarifying the standard the insulation must meet.

Staff Analysis: The referenced standard, ASTM E2178-13, is currently referenced in the 2018 IECC-Commercial Provisions.

Proposal # 5371

CE19-19 Part II

CE20-19 Part I

PART I — IECC: Part I: C202(New)

IECC: Part II: R202 (N1101.6) (New)

PART II — IECC: R202 (IRC N1101.6)

Proponent: Donald Sivigny, State of Minnesota, 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- COMMERCIAL COMMITTEE. PART II WILL BE HEARD BY THE IECC-RESIDENTIAL COMMITTEE. SEE THE TENTATIVE HEARING ORDER FOR THESE COMMITTEES.

2018 International Energy Conservation Code

SECTION C202 GENERAL DEFINITIONS

Add new definition as follows:

AIR, OUTDOOR. Air that is taken from the external atmosphere, and therefore not previously circulated through the HVAC system or the conditioned space.

Proposal # 5355

CE20-19 Part I

CE20-19 Part II

IECC: R202 (IRC N1101.6)

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

2018 International Energy Conservation Code

SECTION R202 (IRC N1101.6) GENERAL DEFINITIONS

Add new definition as follows:

AIR, OUTDOOR. Air that is taken from the external atmosphere, and therefore not previously circulated through the HVAC system or the conditioned space.

Reason: *There are three types of air addressed in buildings today. They include make-up air, combustion air and ventilation air. Of these three types of air, only ventilation air is addressed in the energy code. Make-up and combustion air are addressed in the Mechanical Code. Since the energy code does not have a definition of Outdoor Air, which is part of the ventilation air for a building, and since the term is used throughout the code, it is important to define what outdoor air is for clarity and use of the code to the code official and builder as well.*

Cost Impact: The code change proposal will not increase or decrease the cost of construction. This change is simply defining one of the three airs associated with Buildings. It is good to define them so the user of the code understands the differences.

Proposal # 5763

CE20-19 Part II

CE21-19

IECC: C202(New), C202

Proponent: jim edelson, representing New Buildings Institute (jim@newbuildings.org)

2018 International Energy Conservation Code

SECTION C202 GENERAL DEFINITIONS

Add new definition as follows:

BIOMASS GAS. A medium Btu gas containing methane and carbon dioxide, resulting from the action of microorganisms on organic materials such as a landfill.

BIOMASS WASTE. Organic non-fossil material of biological origin that is a byproduct or a discarded product. Biomass waste includes municipal solid waste from biogenic sources, landfill gas, sludge waste, agricultural crop byproducts, straw, and other biomass solids, liquids, and gases; but excludes wood and wood-derived fuels (including black liquor), biofuels feedstock, biodiesel, and fuel ethanol.

Revise as follows:

ON-SITE RENEWABLE ENERGY. Energy derived from solar radiation, wind, waves, tides, ~~landfill biomass gas, biogas, biomass or the internal heat of waste or extracted from hot fluid or steam heated within the earth.~~ The energy system providing on-site renewable energy shall be located on the ~~project~~ building site.

Reason: The existing definition in IECC dates to the 2012 IECC. It was proposed by the team of New Buildings Institute, US Department of Energy and American Institute of Architects. It was one clause in a comprehensive overhaul of the 2009 IECC. When it was written in 2010, it was the first time that renewable energy had been defined in an I-code, and it reflected a very early understanding of a much less mature industry. It has not been significantly revised since.

This proposal does indeed update the language by further refining biomass energy sources with terms that were not available at the time it was drafted in 2010. Revised language makes the proper distinction between geothermal energy sources and geothermal heat pumps. The revision also limits the biomass sources to those that meet specifications as waste products. There are many flavors of biomass energy, but this proposal ensures that virgin material of unknown origin is not used as a steady source of energy, which in the provisions of C406 is a trade-off for energy efficiency features of the building. The definitions of *biomass gas* and *biomass waste* are taken from the glossary of the Energy Information Administration.

This proposal does not restrict the geographic sourcing of the waste material, but it does ensure that the system converting the fuel is located on the building site.

Bibliography: U.S. Energy Information Administration Glossary; <https://www.eia.gov/tools/glossary/>

Cost Impact: The code change proposal will not increase or decrease the cost of construction. This proposal is a definition of renewable energy that will not have an impact on construction costs. The modification of the definition only applies only to the fuel used after occupancy.

CE22-19 Part I

PART I — IECC: Part I: C202

IECC: Part II: R202 (N1101.6)

PART II — IECC: R202 (IRC N1101.6)

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

SECTION C202 GENERAL DEFINITIONS

CIRCULATING HOT WATER SYSTEM. A specifically designed water distribution system where one or more pumps are operated in the service hot water piping to circulate heated water from the water-heating equipment to the fixture supply and back to the water-heating equipment.

Revise as follows:

DEMAND RECIRCULATION WATER SYSTEM. A water distribution system ~~having where~~ one or more recirculation pumps that pump water from a heated water supply pipe back to the heated water source through ~~a cold water supply pipe.~~ pumps prime the service hot water piping with heated water upon a demand for hot water.

Proposal # 4760

CE22-19 Part I

CE22-19 Part II

IECC: R202 (IRC N1101.6)

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

SECTION R202 (IRC N1101.6) GENERAL DEFINITIONS

CIRCULATING HOT WATER SYSTEM. A specifically designed water distribution system where one or more pumps are operated in the service hot water piping to circulate heated water from the water-heating equipment to fixtures and back to the water-heating equipment.

Revise as follows:

DEMAND RECIRCULATION WATER SYSTEM. A water distribution system ~~having where one or more recirculation pumps that pump water from a heated water supply pipe back to the heated water source through a cold water supply pipe.~~ pumps prime the service hot water piping with heated water upon demand for hot water.

Reason: This code change replicates the IPC definitions for "demand recirculation water systems definition". This provides consistency in the use of the term between the two codes. The "circulating hot water system" definition is already consistent, and is included here for reference and context.

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>

(<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 change does not add to nor detract from the design and construction requirements.

Proposal # 5753

CE22-19 Part II

CE23-19 Part I

PART I — IECC: Part I: C202(New)

IECC: Part II: R202 (N1101.6) (New)

PART II — IECC: R202 (IRC N1101.6)

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

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

2018 International Energy Conservation Code

SECTION C202 GENERAL DEFINITIONS

Add new definition as follows:

COMPLIANCE REPORT. Documents created to demonstrate compliance with the intent of the code for the purpose of obtaining the building permit and subsequently acquiring the certificate of occupancy.

Proposal # 4792

CE23-19 Part I

CE23-19 Part II

IECC: R202 (IRC N1101.6)

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

2018 International Energy Conservation Code

SECTION R202 (IRC N1101.6) GENERAL DEFINITIONS

Add new definition as follows:

COMPLIANCE REPORT Documents created to demonstrate compliance with the intent of the code for the purpose of obtaining the building permit and subsequently acquiring the certificate of occupancy.

Proposal # 5798

CE23-19 Part II

CE24-19

IECC: C202

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

2018 International Energy Conservation Code

SECTION C202 GENERAL DEFINITIONS

Revise as follows:

COMPUTER ROOM. A room whose primary function is to house equipment for the processing and storage of electronic data and that has a design electronic data equipment power density of ~~less~~ greater than 20 watts per square foot (20 watts per 0.092 m²) of conditioned floor area or a connected design electronic data equipment load of ~~less~~ greater than 10 kW.

Reason: Why is the proposed code change needed?

Computer room spaces are designed with watt densities greatly exceeding 20 watts per square foot. This is an obvious error. In checking with the ASHRAE 90.1 definition, they identify greater than 20 watts per square foot.

Why is the proposed code change a reasonable solution? Because it corrects the metric parameters that define a space as a Computer Room.

Cost Impact: The code change proposal will not increase or decrease the cost of construction. This Change will not alter the cost of the Building as it is only a typographical correction.

Proposal # 5120

CE24-19

CE25-19

IECC: C202(New)

Proponent: Hope Medina, representing Self (hmedina@coloradocode.net)

2018 International Energy Conservation Code

SECTION C202 GENERAL DEFINITIONS

Add new definition as follows:

CORE AND SHELL. The construction of the base building including but not limited to exterior structural walls, structural columns, roof structure including covering, floor structure, and exterior cladding. The defined thermal envelope including insulation in all required locations, the air barrier, and air sealing must be installed. Utilities are brought to the structure with limited installment within the structure. The required grading per the International Building Code and approved construction documents, and include a route to the building from the public way.

Reason: The intent of this definition is to define when a project is considered a core and shell, and what the requirements are. This will help to alleviate the discussion on who is responsible for which energy requirements at which stage of construction and build out.

Cost Impact: The code change proposal will not increase or decrease the cost of construction. This definition may shift the cost from one party of a project to another.

Staff Analysis: The purpose of providing definitions in I=Codes is to define terms using in that specific I-code. The term 'core and shell' is not used in the IECC.

Proposal # 5502

CE25-19

CE26-19 Part I

IECC: C202 (New), C403.6.1

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

2018 International Energy Conservation Code

SECTION C202 GENERAL DEFINITIONS

Add new definition as follows:

DIRECT DIGITAL CONTROL (DDC) a type of control where controlled and monitored analog or binary data such as temperature and contact closures, are converted to digital format for manipulation and calculations by a digital computer or microprocessor, then converted back to analog or binary form to control physical devices.

Revise as follows:

C403.6.1 Variable air volume and multiple-zone systems. Supply air systems serving multiple zones shall be variable air volume (VAV) systems that have zone controls configured to reduce the volume of air that is reheated, recooled or mixed in each zone to one of the following:

1. Twenty percent of the zone design peak supply for systems with direct digital control (DDC) and 30 percent for other systems.
2. Systems with *DDC* where all of the following apply:
 - 2.1. The airflow rate in the deadband between heating and cooling does not exceed 20 percent of the zone design peak supply rate or higher allowed rates under Items 3, 4 and 5 of this section.
 - 2.2. The first stage of heating modulates the zone supply air temperature setpoint up to a maximum setpoint while the airflow is maintained at the deadband flow rate.
 - 2.3. The second stage of heating modulates the airflow rate from the deadband flow rate up to the heating maximum flow rate that is less than 50 percent of the zone design peak supply rate.
3. The outdoor airflow rate required to meet the minimum ventilation requirements of Chapter 4 of the International Mechanical Code.
4. Any higher rate that can be demonstrated to reduce overall system annual energy use by offsetting re-heat/recool energy losses through a reduction in outdoor air intake for the system as approved by the code official.
5. The airflow rate required to comply with applicable codes or accreditation standards such as pressure relationships or minimum air change rates.

Exception: The following individual zones or entire air distribution systems are exempted from the requirement for VAV control:

1. *Zones* or supply air systems where not less than 75 percent of the energy for reheating or for providing warm air in mixing systems is provided from a site-recovered, including condenser heat, or site-solar energy source.
2. Systems that prevent reheating, recooling, mixing or simultaneous supply of air that has been previously cooled, either mechanically or through the use of economizer systems, and air that has been previously mechanically heated.

Reason: Section C403.6.1 makes reference to "DDC" but nowhere in the code does it tell you what that is. there were a few different proposals for the 2018 IECC that covered DDC but the one that had the definition didn't pass so it left a hole here. we were hoping this would be handled by an errata but that never happened so we are bringing forth the definition as currently found in ASHRAE 90.1. We also added the italicized wording to the code section for clarity.

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

Proposal # 5427

CE26-19 Part I

CE27-19

IECC: C202

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

2018 International Energy Conservation Code

SECTION C202 GENERAL DEFINITIONS

Revise as follows:

GREENHOUSE. A structure or a thermally isolated area of a building that maintains a specialized sunlit environment exclusively used for, and essential to, the cultivation, protection or maintenance of plants.
Greenhouse buildings or spaces have their own thermal envelope requirements that are independent of the rest of the conditioned spaces within the building.

Reason: 1. Why is the proposed code change needed?

It has been identified that an interpretation could be made that Section C403.12, Mechanical systems located outside of the building thermal environment could apply to greenhouse spaces, which is not the intent. This proposed change clearly identifies that greenhouses have their own building thermal envelopes, and therefore would not be defined as a space "outside the building thermal envelope."

2. Why is the proposed code change a reasonable solution?

It easily clarifies an interpretation

Cost Impact: The code change proposal will not increase or decrease the cost of construction
There is no Cost Change as this proposal only provides clarifying in a definition.

Proposal # 5351

CE27-19

CE28-19 Part I

PART I — IECC: Part I: C202

IECC: Part II: R202 (N1101.6)

PART II — IECC: R202 (IRC N1101.6)

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

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

2018 International Energy Conservation Code

SECTION C202 GENERAL DEFINITIONS

GROUP R. Buildings or portions of buildings that contain any of the following occupancies as established in the International Building Code:

1. *Group R-1.*
2. *Group R-2* ~~where located more than three stories in height above grade plane.~~
3. *Group R-4* where located more than three stories in height above grade plane.

RESIDENTIAL BUILDING. For this code, includes detached one- and two-family dwellings and multiple single-family dwellings (townhouses) and ~~Group R-2,~~ R-3 and R-4 buildings three stories or less in height above grade plane.

Proposal # 5652

CE28-19 Part I

CE28-19 Part II

IECC: R202 (IRC N1101.6)

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

2018 International Energy Conservation Code

SECTION R202 (IRC N1101.6) GENERAL DEFINITIONS

Revise as follows:

RESIDENTIAL BUILDING. For this code, includes detached one- and two-family dwellings and multiple single-family dwellings (townhouses) and ~~Group R-2, R-3~~ and R-4 buildings three stories or less in height above grade plane.

Reason: Multifamily poses a conundrum for energy regulation. Generally, these buildings are constructed and renovated like commercial buildings, but used like residential buildings. As a result, the regulation of multifamily buildings has been split between the residential and the commercial codes. Multifamily buildings that are four stories and higher are considered high-rise and regulated by the commercial chapter of the International Energy Conservation Code (IECC). However, with their residential usage patterns and loads, they don't truly fit a commercial code with its focus on commercial loads and usage patterns. Multifamily buildings that are three stories or lower are regulated by the residential chapter of the IECC. However, with their larger size and higher occupant density, these low-rise multifamily buildings don't truly fit in a residential energy code with its focus on single family homes.

The result is energy regulation that does not adequately serve the multifamily market:

- Regulation by two different energy codes complicates both code compliance and code enforcement.
- Neither the Commercial nor the Residential code was crafted to address the unique characteristics of the multifamily building type.
- Advancing the energy code for multifamily is hindered by the necessity of pursuing changes simultaneously in two different codes, both of which are dominated by issues of building types other than multifamily.
- The presence of two different code baselines has made it very difficult to create above-code energy standards and efficiency programs that apply to all multifamily buildings.
- The IECC is delivering different energy outcomes for low-rise and high-rise multifamily buildings, even those that are very similar.

This proposal will solve these problems by simply placing all R-2 buildings (the occupancy that covers what is traditionally considered multifamily), regardless of height, under the commercial section of the code. Many small commercial buildings are constructed using the same construction methods, materials and equipment that are common in low-rise multifamily, so buildings like low-rise multifamily are already subject to the commercial requirements. This is the solution that has been chosen in Boulder, CO to solve this issue. A more comprehensive proposal that would have minimized the stringency impact of unifying high-rise and low-rise multifamily under one set of requirements was attempted in the 2018 code cycle, but ultimately was disapproved due to its complexity. This solution is far simpler and more straightforward, while still solving all the issues identified above.

If this proposal is adopted, the IECC will be improved substantially for its use with multifamily buildings:

- Both code compliance and code enforcement will be less complicated and therefore less costly
- The energy code will more directly address multifamily buildings
- A single code baseline will make it easier to create an above-code standard for Green standards, utility programs and recognition programs above-code standards, Green Standards, utility incentive programs, and other recognition efforts
- Multifamily code issues will no longer complicate the development of the Residential and Commercial codes*

* The entire process was informed by an energy analysis performed by the Pacific Northwest National Lab. Part of this analysis included comparing a 3-story building under the residential requirements to an otherwise identical 4-story building under the commercial requirements. The 3-story building had an EUI 7-10% higher than its 4-story counterpart. This result shows that the two sets of energy requirements in the code result in significantly different energy outcomes in multifamily buildings. This fact emphasizes the importance of this effort to bring coherence to the multifamily market.

Cost Impact: The code change proposal will increase the cost of construction. This proposal may increase the cost of construction since it will require low-rise MF buildings to meet commercial provisions of the code.

Proposal # 5785

CE28-19 Part II

CE29-19 Part I

PART I — IECC: Part I: C202

IECC: Part II: R202 (IRC N1101.6), R303.3 (IRC N1101.12), R403.5.1 (IRC N1103.5.1), R403.10.1 (IRC N1103.10.1)

PART II — IECC: R202 (IRC N1101.6), R303.3 (IRC N1101.12), R403.5.1 (IRC N1103.5.1), R403.10.1 (IRC N1103.10.1)

Proponent: Ed Kulik, representing ICC Building Code Action Committee (bcac@iccsafe.org)

2018 International Energy Conservation Code

SECTION C202 GENERAL DEFINITIONS

Revise as follows:

NETWORKED GUESTROOM CONTROL SYSTEM. A control system, ~~accessible~~ with access from the front desk or other central location associated with a Group R-1 building, that is capable of identifying the occupancy status of each guestroom according to a timed schedule, and is capable of controlling HVAC in each hotel and motel guestroom separately.

Proposal # 4072

CE29-19 Part I

CE29-19 Part II

IECC: R202 (IRC N1101.6), R303.3 (IRC N1101.12), R403.5.1 (IRC N1103.5.1), R403.10.1 (IRC N1103.10.1)

Proponent: Ed Kulik, representing ICC Building Code Action Committee (bcac@iccsafe.org)

2018 International Energy Conservation Code

SECTION R202 (IRC N1101.6) GENERAL DEFINITIONS

Revise as follows:

ACCESSIBLE. ~~Admitting close approach as a result of not being guarded by locked doors, elevation or other effective means (see "Readily accessible").~~

READILY ACCESSIBLE. ~~Capable of being reached quickly for operation, renewal or inspection without requiring those to whom ready access is requisite to climb over or remove obstacles or to resort to portable ladders or access equipment (see "Accessible").~~

READY ACCESS (TO) That which enables a device, appliance or equipment to be directly reached, without requiring the removal or movement of any panel, or similar obstruction.

ACCESS (TO) That which enables a device, appliance or equipment to be reached by ready access or by a means that first requires the removal or movement of a panel, or similar obstruction.

R303.3 (IRC N1101.12) Maintenance information. Maintenance instructions shall be furnished for equipment and systems that require preventive maintenance. Required regular maintenance actions shall be clearly stated and incorporated on a readily ~~accessible~~ visible label. The label shall include the title or publication number for the operation and maintenance manual for that particular model and type of product.

R403.5.1 (IRC N1103.5.1) Heated water circulation and temperature maintenance systems (Mandatory). Heated water circulation systems shall be in accordance with Section R403.5.1.1. Heat trace temperature maintenance systems shall be in accordance with Section R403.5.1.2. Automatic controls, temperature sensors and pumps shall be ~~accessible~~ in a location with access. Manual controls shall be ~~readily accessible~~ in a location with ready access.

R403.10.1 (IRC N1103.10.1) Heaters. The electric power to heaters shall be controlled by a ~~readily accessible~~ an 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~~ heater in a location with ready access. 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: The reason for this change is that "accessible" is typically understood to be reachable by a person using a wheelchair. This is not the case in the sections shown to be revised. The revised language will clarify where the requirement is intended for inspection or repair.

Last cycle, CE137-16 Part 1 was approved by the commercial energy and disapproved by the residential energy. The IECC residential committee's reason was "These terms are going to be too difficult to explain to contractors."

The term 'accessible' is defined in the IBC and relates to elements and facilities that serve or have special accommodations for persons with mobility impairments. The IPC and IMC use the term "Access (to)" or "Ready

Access" for access to equipment which is proposed here for the IECC. A similar proposal was approved for the all the other codes.

One new definition in the Commercial Energy picked up "accessible". That should be revised.

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 an editorial issue with no code changes.

Proposal # 5784

CE29-19 Part II

CE30-19 Part I

PART I — IECC: Part I: C202 (New)

IECC: Part II: R202(N1101.6) (New)

PART II — IECC: SECTION R202, (New)

Proponent: Hope Medina, representing Self (hmedina@coloradocode.net)

2018 International Energy Conservation Code

SECTION C202 GENERAL DEFINITIONS

Add new definition as follows:

REMODEL. A change in a building's interior or exterior from the original construction

Proposal # 5496

CE30-19 Part I

CE30-19 Part II

IECC: SECTION R202, (New)

Proponent: Hope Medina, representing Self (hmedina@coloradocode.net)

2018 International Energy Conservation Code

SECTION R202 (IRC N1101.6) GENERAL DEFINITIONS

Add new definition as follows:

REMODEL. A change in a building's interior or exterior from the original construction

Staff Analysis: The purpose of providing definitions in I=Codes is to define terms using in that specific I-code. The term 'remodel' is not used in the IECC.

Proposal # 5813

CE30-19 Part II

CE31-19 Part I

PART I — IECC Part I: C202, C202(New)
IECC Part II R202(N1101.6)(New)

PART II — IECC: R202 (IRC N1101.6)

Proponent: jim edelson, New Buildings Institute, representing New Buildings Institute (jim@newbuildings.org)

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

2018 International Energy Conservation Code

SECTION C202 GENERAL DEFINITIONS

Revise as follows:

ON-SITE RENEWABLE ENERGY. ~~Energy derived from solar radiation, wind, waves, tides, landfill gas, biogas, biomass or the internal heat of the earth. The energy system providing on-site renewable energy shall be located on the project site.~~ renewable energy resources harvested at the building site.

Add new text as follows:

RENEWABLE ENERGY RESOURCES. Energy derived from solar radiation, wind, waves, tides, landfill gas, biogas, biomass or extracted from hot fluid or steam heated within the earth.

Proposal # 4970

CE31-19 Part I

CE31-19 Part II

IECC: R202 (IRC N1101.6)

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:

ON-SITE RENEWABLE ENERGY. Energy from renewable energy resources harvested at the building site.

RENEWABLE ENERGY RESOURCES. Energy derived from solar radiation, wind, waves, tides, landfill gas, biogas, biomass or extracted from hot fluid or steam heated within the earth.

Reason: There has been a definition of "onsite renewable energy" since 2012 in the commercial IECC. The term was first used in the IECC residential code in 2018, but no definition was included at that time. This proposal adds an updated version of that definition that is simultaneously being proposed for the commercial IECC. Some of the modifications are based on language that has been deliberated by an ASHRAE workgroup for over six months and is pending at ASHRAE 90.1 (at the time of this submittal). This proposal could establish consistency between IECC-residential, IECC-commercial, and ASHRAE 90.1, thereby simplifying compliance and enforcement for onsite renewable energy installations.

The listed energy resources in the definition are similar to those found in the current IECC definition with the exception of "extracted from hot fluid or steam heated within the earth". That proposed revision from the current definition makes the distinction between geothermal energy sources and geothermal heat pumps.

When these are accepted as definitions into this portion of the code, staff will be able to italicize the use of the terms such as in the definitions and the Footnote a to Table R406.4.

Bibliography: Addendum *by* to Standard 90.1-2016, Energy Standard for Buildings Except Low-Rise Residential Buildings; ASHRAE, January 2018. (pending at the time of submittal)

Cost Impact: The code change proposal will not increase or decrease the cost of construction. This proposal is a definition of renewable energy that will not have an impact on construction costs.

Proposal # 4976

CE31-19 Part II

CE32-19 Part I

PART I — IECC Part I: C202

IECC Part II R202(N1101.6)

PART II — IECC: R202 (IRC N1101.6)

Proponent: Joseph Hill, NYSDOS, representing NYSDOS (Joseph.Hill@dos.ny.gov)

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

2018 International Energy Conservation Code

SECTION C202 GENERAL DEFINITIONS

Revise as follows:

STANDARD REFERENCE DESIGN. A version of the proposed design ~~that meets the minimum~~ which has been programmed to meet the the minimum prescriptive and mandatory requirements of this code. The proposed design is measured against the standard reference design and is used to determine the maximum annual energy use requirement for compliance based on total building performance.

Proposal # 4892

CE32-19 Part I

CE32-19 Part II

IECC: R202 (IRC N1101.6)

Proponent: Joseph Hill, NYSDOS, representing NYSDOS (Joseph.Hill@dos.ny.gov)

2018 International Energy Conservation Code

SECTION R202 (IRC N1101.6) GENERAL DEFINITIONS

STANDARD REFERENCE DESIGN. A version of the proposed design ~~that meets the minimum which has been programmed to meet the the minimum prescriptive and mandatory requirements of this code code. The proposed design is measured against the standard reference design~~, and is used to determine the maximum annual energy use requirement for compliance based on total building performance.

Reason: There has been some degree of confusion in the meaning of a "Standard Reference Design". The revised definition may serve to clarify its' intended meaning and its' use.

Bibliography: IECC 2018

Cost Impact: The code change proposal will not increase or decrease the cost of construction
This is a clarification which does not impact the current code requirement, nor its operation

Proposal # 5759

CE32-19 Part II

CE33-19

IECC C202(New)

Proponent: Hope Medina, representing Self (hmedina@coloradocode.net)

2018 International Energy Conservation Code

SECTION C202 GENERAL DEFINITIONS

Add new definition as follows:

TENANT FINISH. The first time a building or space that is completed for a specific use. This shall include but is not limited to the interior wall locations, wall coverings, flooring, plumbing fixtures, electrical fixtures, and mechanical installation.

Reason: The definition is to clarify when a project should be referred to as a tenant finish and when it should be referred to as a remodel. This will also clarify when certain requirements are required for each type of project.

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

Staff Analysis: The purpose of providing definitions in I-codes is to define terms used in that specific I-code. The term “tenant finish” is not used in the IECC.

Proposal # 5490

CE33-19

CE34-19 Part I

PART I — IECC: Part I: C202
IECC: Part II: R202 (N1101.6)

PART II — IECC: R202 (IRC N1101.6)

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- COMMERCIAL COMMITTEE.
PART II WILL BE HEARD BY THE IECC-RESIDENTIAL COMMITTEE. SEE THE TENTATIVE HEARING ORDER
FOR THESE COMMITTEES.

2018 International Energy Conservation Code

SECTION C202 GENERAL DEFINITIONS

Revise as follows:

U-FACTOR (THERMAL TRANSMITTANCE). The coefficient of heat transmission (air to air) through a building component or assembly, inclusive of the inside and outside air films, equal to the time rate of heat flow per unit area and unit temperature difference between the warm side and cold side air films of the building component or assembly (Btu/h • ft² • °F)[W/(m² • K)].

Proposal # 5353

CE34-19 Part I

CE34-19 Part II

IECC: R202 (IRC N1101.6)

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

2018 International Energy Conservation Code

SECTION R202 (IRC N1101.6) GENERAL DEFINITIONS

U-FACTOR (THERMAL TRANSMITTANCE). The coefficient of heat transmission (air to air) through a building component or assembly, inclusive of the inside and outside air films, equal to the time rate of heat flow per unit area and unit temperature difference between the warm side and cold side air films of the building component or assembly (Btu/h • ft² • °F) [W/(m² • K)].

Reason: 1. Why is the proposed code change needed?

The definition as presented in the IECC is not correct or could be miss-interpreted. The U-Factor includes the inside and outside air films. Not including the results in an erroneous value.

2. Why is the proposed code change a reasonable solution?

It corrects or clarifies the definition of the U factor.

The U factor is a value that is used to show compliance with the insulation requirements, or used in calculations to show that building system perform in compliance with the code requirements. Not calculating it correctly could have an impact on verifying compliance with the code requirements.

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

There will be no added or saved costs by clarifying the definition of U-factor. It is simply clarifying a definition that was not complete in the current Code.

Proposal # 5764

CE34-19 Part II

CE35-19

IECC: C202

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

2018 International Energy Conservation Code

SECTION C202 GENERAL DEFINITIONS

Revise as follows:

WALL, ABOVE-GRADE. A wall associated with the *building thermal envelope* that is more than 15 percent above grade and is on the exterior of the building or any wall that is associated with the *building thermal envelope* that is not on the exterior of the building. This includes, but is not limited to, between-floor spandrels, peripheral edges of floors, roof and basement knee walls, dormer walls, gable end walls, walls enclosing a mansard roof and skylight shafts.

Reason: The current definition of above-grade wall is general and vague and allows for an interpretation that ignores the thermal performance of important building elements. For example, the existing definition is not clear that exposed floor edges are part of the above-grade wall. Depending on how the code is interpreted/enforced, this could leave this building element unregulated.

This change to the definition clarifies it and closes this potential loophole. It is explicitly clear that the critical elements of a building that function as part of the wall component of the thermal envelope, even though they may not be thought of as walls, are regulated as walls. These elements will need to be either insulated to meet the above-grade wall requirements or be incorporated into weighted averages for the performance of the above-grade wall.

The language was drawn from the definition currently used in the WA state energy code.

Cost Impact: The code change proposal will not increase or decrease the cost of construction
This modification clarifies the code and should not increase the cost of construction.

Proposal # 5034

CE35-19

CE36-19 Part I

PART I — IECC: FIGURE C301.1, TABLE C301.1, C301.3, TABLE C301.3(1), TABLE C301.3(2)

PART II — IECC: FIGURE R301.1 (IRC N1101.7), TABLE R301.1 (IRC N1101.7), R301.3 (IRC N1101.7.2), TABLE R301.3(1) [IRC N1101.7.2(1)], TABLE R301.3(2) [IRC N1101.7.2(2)]

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

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

2018 International Energy Conservation Code

SECTION C301 CLIMATE ZONES

C301.1 General. *Climate zones* from Figure C301.1 or Table C301.1 shall be used for determining the applicable requirements from Chapter 4. Locations not indicated in Table C301.1 shall be assigned a *climate zone* in accordance with Section C301.3.

Revise as follows:

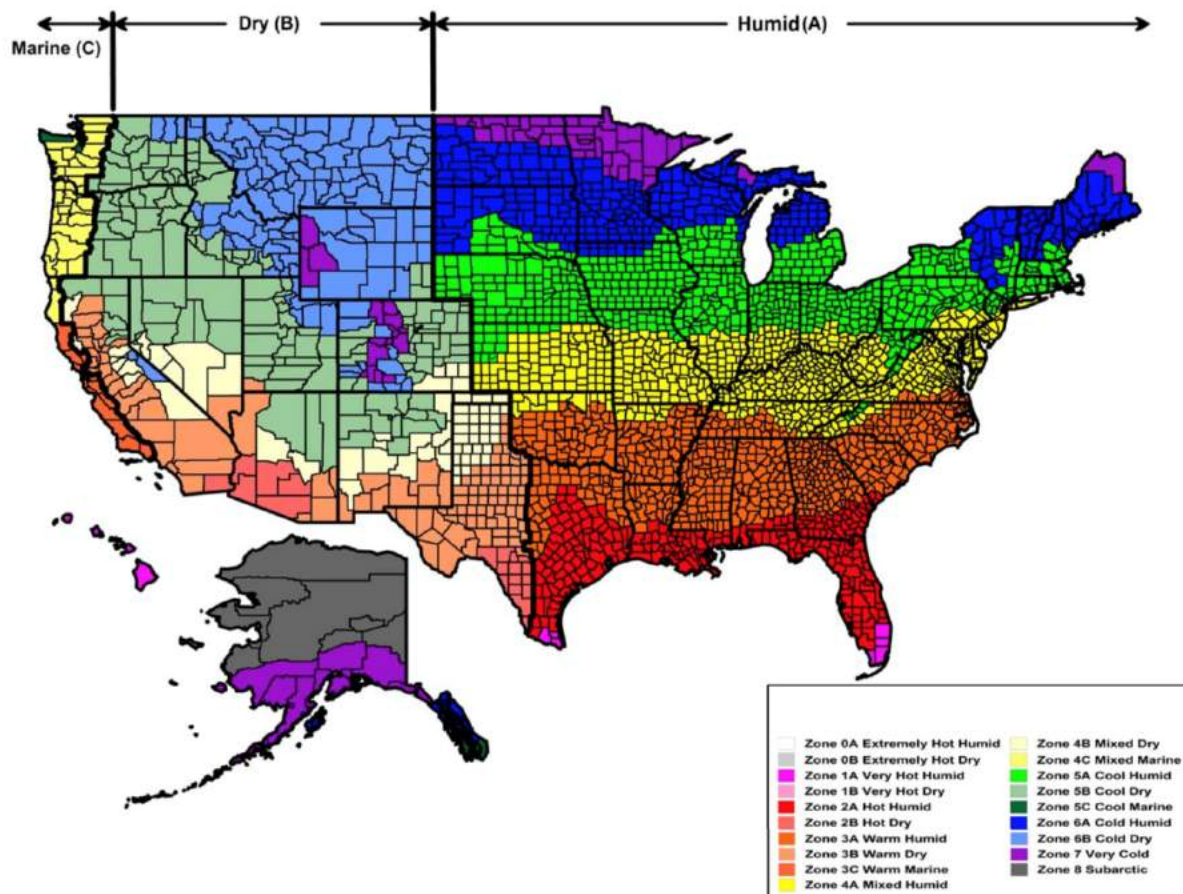
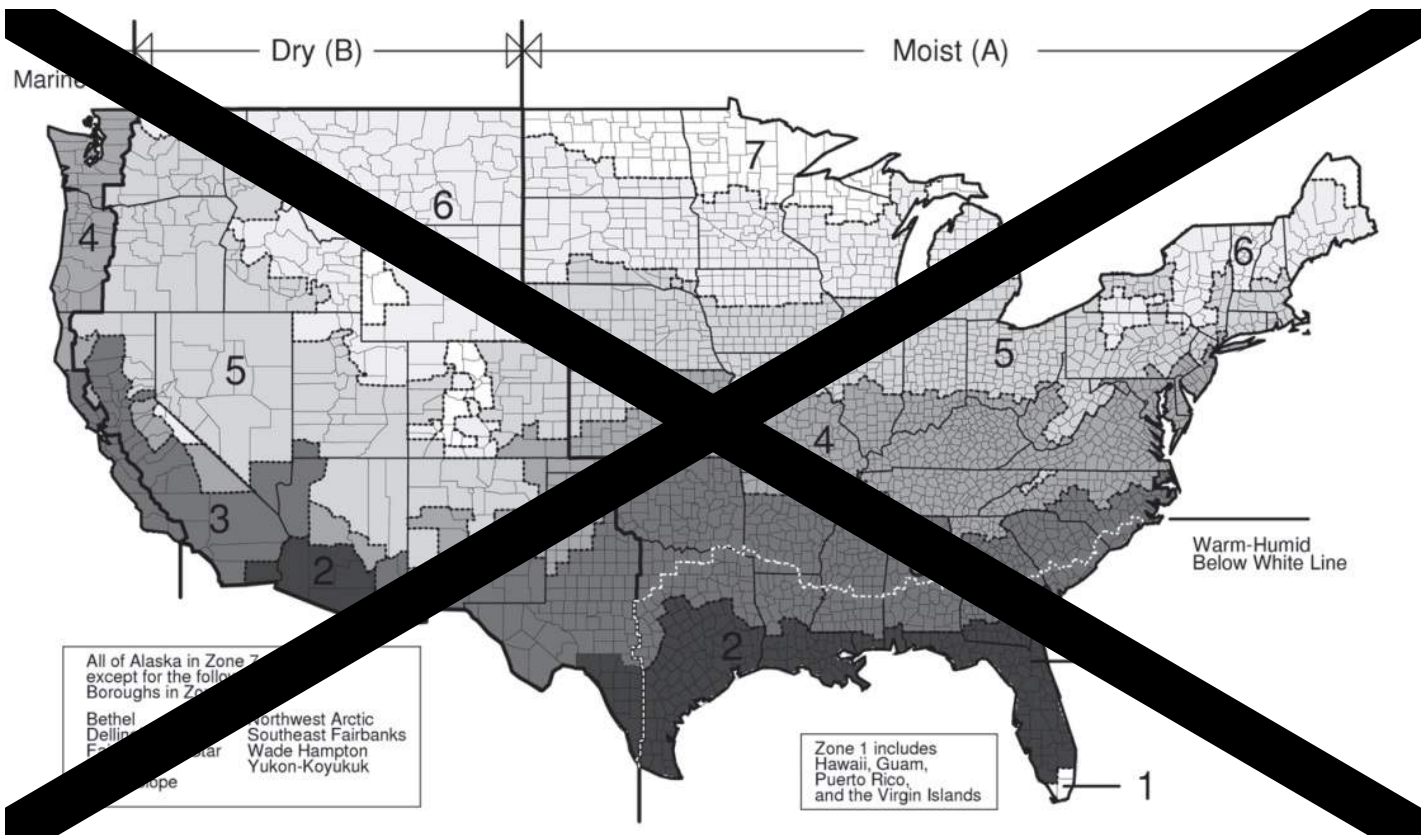


FIGURE C301.1

CLIMATE ZONES

TABLE C301.1

CLIMATE ZONES, MOISTURE REGIMES, AND WARM-HUMID DESIGNATIONS BY STATE, COUNTY AND TERRITORY

Portions of table not shown remain unchanged.

ALABAMA	<u>5A6A</u> Webster	<u>3A4A</u> Vance	<u>2A3A</u> Tarrant*
<u>2A3A</u> Coffee*	<u>5A6A</u> Winneshiek	<u>3A4A</u> Wake	<u>1A2A</u> Willacy*
<u>2A3A</u> Covington*	<u>5A6A</u> Wright	<u>3A4A</u> Warren	UTAH
<u>2A3A</u> Dale*	KANSAS	<u>5A4A</u> Wilkes	<u>5B6B</u> Box Elder
<u>2A3A</u> Escambia*	<u>4A5A</u> Cloud	NORTH DAKOTA	<u>5B6B</u> Cache
<u>2A3A</u> Geneva*	<u>4A5A</u> Ellis	<u>6A7</u> Barnes	<u>5B6B</u> Carbon
<u>2A3A</u> Henry*	<u>4A5A</u> Graham	<u>6A7</u> Cass	VERMONT
<u>2A3A</u> Houston*	<u>4A5A</u> Hamilton	<u>6A7</u> Eddy	VIRGINIA
ALASKA	<u>4A5A</u> Lane	<u>6A7</u> Foster	4A (all <u>except</u> as follows:)
<u>78</u> Bethel	<u>4A5A</u> Mitchell	<u>6A7</u> Griggs	<u>5A</u> Alleghany
<u>87</u> Denali	<u>4A5A</u> Ness	<u>6A7</u> Kidder	<u>5A</u> Bath
<u>78</u> Dillingham	<u>4A5A</u> Osborne	<u>6A7</u> McLean	<u>3A</u> Brunswick
<u>6A7</u> Haines	<u>4A5A</u> Rooks	<u>6A7</u> Mountrail	<u>3A</u> Chesapeake city
<u>6A7</u> Juneau	<u>4A5A</u> Trego	<u>6A7</u> Sheridan	<u>5A</u> Clifton Forge city
<u>5C7</u> Ketchikan Gateway	KENTUCKY	<u>6A7</u> Steele	<u>5A</u> Covington city
<u>6A7</u> Kodiak Island	LOUISIANA	<u>6A7</u> Stutsman	<u>3A</u> Emporia city
<u>5C7</u> Prince of Wales Outer Ketchikan	MAINE	<u>6A7</u> Traill	<u>3A</u> Franklin city
<u>5C7</u> Sitka	MARYLAND	<u>6A7</u> Wells	<u>3A</u> Greenville
<u>6A7</u> Skagway-Hoonah-Angoon	<u>5A4A</u> Allegany	<u>6A7</u> Williams	<u>3A</u> Halifax
<u>6A7</u> Wrangell-Petersburg	MASSACHSETTS	OHIO	<u>3A</u> Hampton city
ARIZONA	MICHIGAN	<u>4A5A</u> Athens	<u>5A</u> Highland
ARKANSAS	<u>6A7</u> Baraga	<u>4A5A</u> Butler	<u>3A</u> Isle of Wight
CALIFORNIA	<u>6A7</u> Chippewa	<u>4A5A</u> Clinton	<u>3A</u> Mecklenburg
COLORADO	<u>6A7</u> Gogebic	<u>4A5A</u> Fayette	<u>3A</u> Newport News city
<u>4B5B</u> Bent	<u>6A7</u> Houghton	<u>4A5A</u> Franklin	<u>3A</u> Norfolk city
<u>5B6B</u> Custer	<u>5A6A</u> Huron	<u>4A5A</u> Greene	<u>3A</u> Pittsylvania
<u>4B5B</u> Prowers	<u>6A7</u> Iron	<u>4A5A</u> Highland	<u>3A</u> Portsmouth city
CONNECTICUT	<u>6A7</u> Luce	<u>4A5A</u> Hocking	<u>3A</u> South Boston
DELAWARE	<u>6A7</u> Mackinac	<u>4A5A</u> Jackson	<u>3A</u> Southampton
DISTRICT OF COLUMBIA	<u>76A</u> Marquette	<u>4A5A</u> Madison	<u>3A</u> Suffolk city
FLORIDA	<u>6A7</u> Ontonagon	<u>4A5A</u> Meigs	<u>3A</u> Surry
<u>1A2A</u> Palm Beach*	<u>5A6A</u> Sanilac	<u>4A5A</u> Pickaway	<u>3A</u> Sussex
GEORGIA	<u>6A7</u> Schoolcraft	<u>4A5A</u> Ross	<u>3A</u> Virginia Beach city
<u>3A4A</u> Banks	MINNESOTA	<u>4A5A</u> Vinton	WASHINGTON

2A3A Calhoun*	6A7 Becker	4A5A Warren	5C4G Clallam
3A4A Catoosa	6A7 Clay	OKLAHOMA	5C4G Island
3A4A Chattooga	5A6A Fillmore	4A3A Alfalfa	5C4G Kitsap
2A3A Coffee*	6A7 Grant	4A3A Craig	5B6B Okanogan
3A4A Dade	5A6A Houston	4A3A Delaware	5C4G San Juan
3A4A Dawson	6A7 Kanabec	4A3A Ellis	WEST VIRGINIA
2A3A Dougherty*	6A7 Mille Lacs	4A3A Garfield	4A5A Doddridge
2A3A Early*	6A7 Otter Tail	4A3A Grant	4A5A Fayette
3A4A Fannin	6A7 Wilkin	4A3A Harper	4A5A Greenbrier
3A4A Floyd	5A6A Winona	4A3A Kay	4A5A Lewis
3A4A Franklin	MISSISSIPPI	4A3A Major	4A5A Nicholas
3A4A Gilmer	2A3A George*	4A3A Nowata	4A5A Raleigh
3A4A Gordon	MISSOURI	4A3A Osage	4A5A Summers
3A4A Habersham	4A5A Buchanan	4A3A Ottawa	4A5A Upshur
3A4A Hall	4A5A Caldwell	4A3A Washington	4A5A Webster
3A4A Lumpkin	4A5A Chariton	4A3A Woods	WISCONSIN
3A4A Murray	4A5A Clinton	4A3A Woodward	5A6A Adams
3A4A Pickens	3A4A Dunklin	OREGON	6A7 Ashland
3A4A Rabun	3A4A Pemiscot	PENNSYLVANIA	6A7 Bayfield
3A4A Stephens	MONTANA	4A5A Adams	6A7 Burnett
2A3A Tift*	NEBRASKA	4A5A Berks	5A6A Calumet
3A4A Towns	NEVADA	5A6A Cameron	5A6A Columbia
3A4A Union	4B5B Carson City (city)	5A6A Clearfield	5A6A Crawford
3A4A Walker	4B5B Douglas	4A5A Cumberland	5A6A Dane
3A4A White	4B5B Esmeralda	4A5A Dauphin	5A6A Dodge
3A4A Whitfield	4B5B Lincoln	5A6A Elk	6A7 Douglas
2A3A Worth*	4B5B Lyon	4A5A Franklin	6A7 Florence
HAWAII	4B5B Mineral	4A5A Lancaster	5A6A Fond du Lac
IDAHO	4B5B Nye	4A5A Lebanon	6A7 Forest
ILLINOIS	NEW HAMPSHIRE	5A6A McKean	5A6A Grant
4A5A Calhoun	5A6A Merrimack	4A5A Perry	5A6A Green
4A5A Clark	NEW JERSEY	5A6A Potter	5A6A Green Lake
4A5A Coles	4A5A Mercer	5A6A Susquehanna	5A6A Iowa
4A5A Cumberland	NEW MEXICO	5A6A Tioga	6A7 Iron
4A5A Greene	4B5B Catron	5A6A Wayne	5A6A Jefferson
4A5A Jersey	3B4B Sierra	RHODE ISLAND	5A6A Juneau
INDIANA	5A6A Allegany	SOUTH CAROLINA	5A6A Kenosha
4A5A Bartholomew	5A6A Broome	2A3A Beaufort*	5A6A La Crosse

4A5A Clay	5A6A Cattaraugus	2A3A Jasper*	5A6A Lafayette
4A5A Decatur	5A6A Schoharie	SOUTH DAKOTA	6A7 Langlade
4A5A Fayette	5A6A Schuyler	5A6A Brule	6A7 Lincoln
4A5A Franklin	5A6A Steuben	5A6A Haakon	5A6A Milwaukee
4A5A Hendricks	5A6A Tompkins	5A6A Jones	5A6A Monroe
4A5A Johnson	5A6A Wyoming	5A6A Lyman	6A7 Oneida
4A5A Marion	NORTH CAROLINA	5A6A Stanley	5A6A Outagamie
4A5A Morgan	3A4A Alamance	TENNESSEE	5A6A Ozaukee
4A5A Owen	3A4A Alexander	3A4A Bedford	6A7 Price
4A5A Putnam	3A4A Bertie	3A4A Coffee	5A6A Racine
4A5A Rush	3A4A Caswell	3A4A Davidson	5A6A Richland
4A5A Shelby	3A4A Catawba	3A4A Decatur	5A6A Rock
4A5A Union	3A4A Chatham	3A4A Franklin	5A6A Sauk
4A5A Vigo	3A4A Cherokee	3A4A Gibson	6A7 Sawyer
IOWA	3A4A Clay	3A4A Giles	6A7 Taylor
5A6A Allamakee	3A4A Cleveland	3A4A Grundy	5A6A Vernon
5A6A Bremer	3A4A Davie	3A4A Hamilton	6A7 Vilas
5A6A Buchanan	3A4A Durham	3A4A Hickman	5A6A Walworth
5A6A Buena Vista	3A4A Forsyth	4A3A Lake	6A7 Washburn
5A6A Butler	3A4A Franklin	3A4A Lawrence	5A6A Washington
5A6A Calhoun	3A4A Gates	3A4A Lewis	5A6A Waukesha
5A6A Cherokee	3A4A Granville	3A4A Lincoln	5A6A Waushara
5A6A Chickasaw	3A4A Guilford	3A4A Marion	5A6A Winnebago
5A6A Clayton	3A4A Halifax	3A4A Marshall	WYOMING
5A6A Delaware	3A4A Harnett	3A4A Maury	5B6B Laramie
5A6A Fayette	3A4A Hertford	3A4A Moore	US TERRITORIES
5A6A Floyd	3A4A Iredell	3A4A Perry	AMERICAN SAMOA
5A6A Franklin	3A4A Lee	3A4A Rutherford	GUAM
5A6A Grundy	3A4A Lincoln	3A4A Wayne	NORTHERN MARIANA ISLANDS
5A6A Hamilton	4A5A Mitchell	3A4A Williamson	PUERTO RICO
5A6A Hardin	3A4A Nash	TEXAS	1A (all <u>except as follows:</u>)*
5A6A Howard	3A4A Northampton	1A2A Cameron*	2B Barraquitas
5A6A Humboldt	3A4A Orange	2A3A Dallas*	2B Cayey
5A6A Ida	3A4A Person	2A3A Ellis*	VIRGIN ISLANDS
5A6A Plymouth	3A4A Polk	1A2A Hidalgo*	
5A6A Pocahontas	3A4A Rockingham	2A3A Johnson*	
5A6A Sac	3A4A Rutherford	2A3A Navarro*	

C301.3 International climate zones. Climate Zone Definitions The *climate zone* for any location outside the

United States shall be determined by applying Table C301.3(1) and then Table C301.3(2).

To determine the climate zones for locations not listed in this code, use the following information to determine climatezone numbers and letters.

Determine the thermal climate zone, 0–8, from Table C301.3(1) using the heating and cooling degree-days for the location. Determine the moisture zone (Marine, Dry or Humid):

a. If monthly average temperature and precipitation data are available, use the Marine, Dry, and Humid definitions below to determine the moisture zone (C, B, or A).

b. If annual average temperature information (including degree-days) and annual precipitation (i.e. annual mean) are available, use the following to determine the moisture zone:

1. If thermal climate zone is 3 and $CDD_{50^{\circ}F} \leq 4500$ ($CDD_{10^{\circ}C} \leq 2500$), climate zone is Marine (3C).

2. If thermal climate zone is 4 and $CDD_{50^{\circ}F} \leq 2700$ ($CDD_{10^{\circ}C} \leq 1500$), climate zone is Marine (4C).

3. If thermal climate zone is 5 and $CDD_{50^{\circ}F} \leq 1800$ ($CDD_{10^{\circ}C} \leq 1000$), climate zone is Marine (5C).

Use the third criteria below for determining the Dry/Humid threshold if not Marine (C).

c. If only degree-day information is available, use the following to determine the moisture zone:

1. If thermal climate zone is 3 and $CDD_{50^{\circ}F} \leq 4500$ ($CDD_{10^{\circ}C} \leq 2500$), climate zone is Marine (3C).

2. If thermal climate zone is 4 and $CDD_{50^{\circ}F} \leq 2700$ ($CDD_{10^{\circ}C} \leq 1500$), climate zone is Marine (4C).

3. If thermal climate zone is 5 and $CDD_{50^{\circ}F} \leq 1800$ ($CDD_{10^{\circ}C} \leq 1000$), climate zone is Marine (5C).

It is not possible to assign Dry/Humid splits in this case. Marine (C) Zone Definition—Locations meeting all four of the following criteria:

a. Mean temperature of coldest month between $27^{\circ}F$ ($-3^{\circ}C$) and $65^{\circ}F$ ($18^{\circ}C$)

b. Warmest month mean $< 72^{\circ}F$ ($22^{\circ}C$)

c. At least four months with mean temperatures over $50^{\circ}F$ ($10^{\circ}C$)

d. Dry season in summer. The month with the heaviest precipitation in the cold season has at least three times as much precipitation as the month with the least precipitation in the rest of the year. The cold season is October through March in the Northern Hemisphere and April through September in the Southern Hemisphere.

Dry (B) Definition—Locations meeting the following criteria:

a. Not Marine (C)

b. If 70% or more of the precipitation, P, occurs during the high sun period, then the dry/humid threshold is: $P < 0.44 \times (T - 7)$ (I-P) $P < 20.0 \times (T + 14)$ (SI)

c. If between 30% and 70% of the precipitation, P, occurs during the high sun period, then the dry/humid threshold is: $P < 0.44 \times (T - 19.5)$ (I-P) $P < 20.0 \times (T + 7)$ (SI)

d. If 30% or less of the precipitation, P, occurs during the high sun period, then the dry/humid threshold is: $P < 0.44 \times (T - 32)$ (I-P) $P < 20 \times T$ (SI) where: P = annual precipitation, in. (mm). T = annual mean temperature, °F (°C). Summer or = April through September in the high sun Northern Hemisphere and October period through March in the Southern Hemisphere. Winter or = October through March in the Northern cold season Hemisphere and April through September in the Southern Hemisphere. Humid (A) Definition—Locations that are not Marine (C) and not Dry (B)

Delete without substitution:

TABLE C301.3(1)
INTERNATIONAL CLIMATE ZONE DEFINITIONS

MAJOR CLIMATE TYPE DEFINITIONS	
Marine (C) Definition—Locations meeting all four criteria:	
1.	Mean temperature of coldest month between -3°C (27°F) and 18°C (65°F).
2.	Warmest month mean < 22°C (72°F).
3.	At least four months with mean temperatures over 10°C (50°F).
4.	Dry season in summer. The month with the heaviest precipitation in the cold season has at least three times as much precipitation as the month with the least precipitation in the rest of the year. The cold season is October through March in the Northern Hemisphere and April through September in the Southern Hemisphere.
Dry (B) Definition—Locations meeting the following criteria:	
Not marine and $P_{inf} < 0.44 \times (TF - 19.5)$ [$P_{em} < 2.0 \times (TC + 7)$ in SI units]	
where:	
P_{inf} = Annual precipitation in inches (cm)	
T = Annual mean temperature in °F (°C)	
Moist (A) Definition—Locations that are not marine and not dry.	
Warm-humid Definition—Moist (A) locations where either of the following wet-bulb temperature conditions shall occur during the warmest six consecutive months of the year:	
1.	67°F (19.4°C) or higher for 3,000 or more hours; or
2.	73°F (22.8°C) or higher for 1,500 or more hours.

For SI: °C = [(°F) - 32]/1.8, 1 inch = 2.54 cm.

TABLE C301.3(2 1)
INTERNATIONAL CLIMATE ZONE DEFINITIONS

ZONE NUMBER	THERMAL CRITERIA	
	IP Units	SI Units
0	10,800 < CDD50°F	6000 < CDD10°C
1	9000 < CDD50°F < 10,800	5000 < CDD10°C < 6000

2	6300 < CDD50°F ≤ 9000	3500 < CDD10°C ≤ 5000
3A and 3B	4500 < CDD50°F ≤ 6300 AND HDD65°F ≤ 3600 5400	2500 < CDD10°C ≤ 3500 AND HDD18°C ≤ 2000 3000
4A and 4B	CDD50°F ≤ 4500 <u>6300</u> AND <u>3600 < HDD65°F ≤ 5400</u>	CDD10°C ≤ 3500 <u>2500</u> AND <u>HDD18°C ≤ 3000</u>
3G	HDD65°F ≤ 3600	HDD18°C ≤ 2000
4G	3600 < HDD65°F ≤ 5400	2000 < HDD18°C ≤ 3000
5	<u>CDD50°F < 6300 and 5400 < HDD65°F ≤ 7200</u>	<u>CDD10°C < 3500 and 3000 < HDD18°C ≤ 4000</u>
6	7200 < HDD65°F ≤ 9000	4000 < HDD18°C ≤ 5000
7	9000 < HDD65°F ≤ 12600	5000 < HDD18°C ≤ 7000
8	12600 < HDD65°F	7000 < HDD18°C

For SI: °C = [(°F)-32]/1.8.

C301.4 Tropical climate zone. The tropical *climate zone* shall be defined as:

1. Hawaii, Puerto Rico, Guam, American Samoa, U.S. Virgin Islands, Commonwealth of Northern Mariana Islands; and
2. Islands in the area between the Tropic of Cancer and the Tropic of Capricorn.

Proposal # 4881

CE36-19 Part I

CE36-19 Part II

IECC: FIGURE R301.1 (IRC N1101.7), TABLE R301.1 (IRC N1101.7), R301.3 (IRC N1101.7.2), TABLE R301.3(1) [IRC N1101.7.2(1)], TABLE R301.3(2) [IRC N1101.7.2(2)]

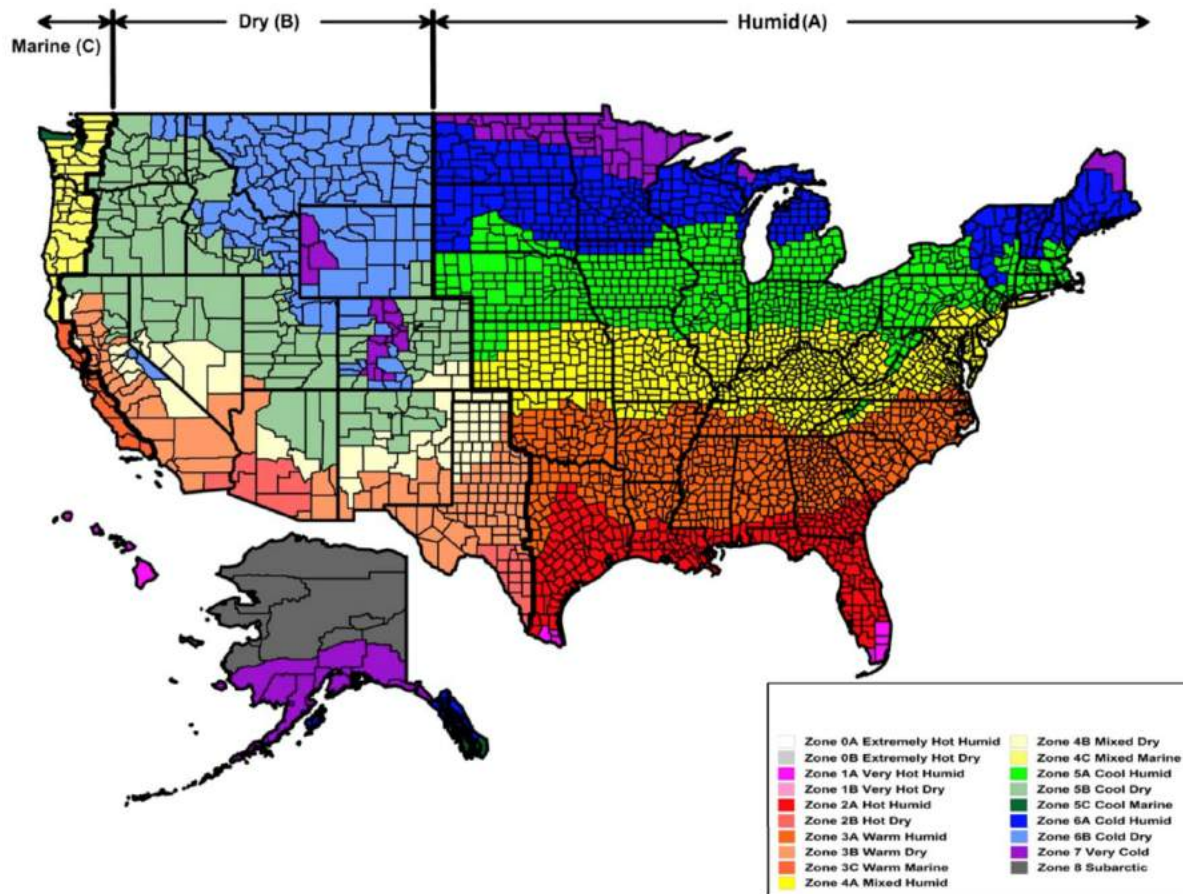
Proponent: David Collins, representing SEHPCAC (SEHPCAC@iccsafe.org); David Collins, representing The American Institute of Architects (dcollins@preview-group.com)

2018 International Energy Conservation Code

SECTION R301 CLIMATE ZONES

R301.1 (IRC N1101.7) General. *Climate zones* from Figure R301.1 or Table R301.1 shall be used for determining the applicable requirements from Chapter 4. Locations not indicated in Table R301.1 shall be assigned a *climate zone* in accordance with Section R301.3.

Revise as follows:



**FIGURE R301.1 (IRC N1101.7)
CLIMATE ZONES**

**TABLE R301.1 (IRC N1101.7)
CLIMATE ZONES, MOISTURE REGIMES, AND WARM-HUMID DESIGNATIONS BY STATE, COUNTY AND
TERRITORY**

Portions of table not shown remain unchanged.

ALABAMA	<u>5A6A</u> Webster	<u>3A4A</u> Vance	<u>2A3A</u> Tarrant*
<u>2A3A</u> Coffee*	<u>5A6A</u> Winneshiek	<u>3A4A</u> Wake	<u>1A2A</u> Willacy*
<u>2A3A</u> Covington*	<u>5A6A</u> Wright	<u>3A4A</u> Warren	UTAH
<u>2A3A</u> Dale*	KANSAS	<u>5A4A</u> Wilkes	<u>5B6B</u> Box Elder
<u>2A3A</u> Escambia*	<u>4A5A</u> Cloud	NORTH DAKOTA	<u>5B6B</u> Cache
<u>2A3A</u> Geneva*	<u>4A5A</u> Ellis	<u>6A7</u> Barnes	<u>5B6B</u> Carbon
<u>2A3A</u> Henry*	<u>4A5A</u> Graham	<u>6A7</u> Cass	VERMONT
<u>2A3A</u> Houston*	<u>4A5A</u> Hamilton	<u>6A7</u> Eddy	VIRGINIA
ALASKA	<u>4A5A</u> Lane	<u>6A7</u> Foster	4A (all <u>except</u> as follows:)
<u>78</u> Bethel	<u>4A5A</u> Mitchell	<u>6A7</u> Griggs	<u>5A</u> Alleghany
<u>87</u> Denali	<u>4A5A</u> Ness	<u>6A7</u> Kidder	<u>5A</u> Bath
<u>78</u> Dillingham	<u>4A5A</u> Osborne	<u>6A7</u> McLean	<u>3A</u> Brunswick
<u>6A7</u> Haines	<u>4A5A</u> Rooks	<u>6A7</u> Mountrail	<u>3A</u> Chesapeake city

<u>6A7</u> Juneau	<u>4A5A</u> Trego	<u>6A7</u> Sheridan	<u>5A</u> Clifton Forge city
<u>5C7</u> Ketchikan Gateway	KENTUCKY	<u>6A7</u> Steele	<u>5A</u> Covington city
<u>6A7</u> Kodiak Island	LOUISIANA	<u>6A7</u> Stutsman	<u>3A</u> Emporia city
<u>5C7</u> Prince of Wales Outer Ketchikan	MAINE	<u>6A7</u> Traill	<u>3A</u> Franklin city
<u>5C7</u> Sitka	MARYLAND	<u>6A7</u> Wells	<u>3A</u> Greenville
<u>6A7</u> Skagway-Hoonah-Angoon	<u>5A4A</u> Allegany	<u>6A7</u> Williams	<u>3A</u> Halifax
<u>6A7</u> Wrangell-Petersburg	MASSACHSETTS	OHIO	<u>3A</u> Hampton city
ARIZONA	MICHIGAN	<u>4A5A</u> Athens	<u>5A</u> Highland
ARKANSAS	<u>6A7</u> Baraga	<u>4A5A</u> Butler	<u>3A</u> Isle of Wight
CALIFORNIA	<u>6A7</u> Chippewa	<u>4A5A</u> Clinton	<u>3A</u> Mecklenburg
COLORADO	<u>6A7</u> Gogebic	<u>4A5A</u> Fayette	<u>3A</u> Newport News city
<u>4B5B</u> Bent	<u>6A7</u> Houghton	<u>4A5A</u> Franklin	<u>3A</u> Norfolk city
<u>5B6B</u> Custer	<u>5A6A</u> Huron	<u>4A5A</u> Greene	<u>3A</u> Pittsylvania
<u>4B5B</u> Prowers	<u>6A7</u> Iron	<u>4A5A</u> Highland	<u>3A</u> Portsmouth city
CONNECTICUT	<u>6A7</u> Luce	<u>4A5A</u> Hocking	<u>3A</u> South Boston
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<u>1A2A</u> Palm Beach*	<u>5A6A</u> Sanilac	<u>4A5A</u> Pickaway	<u>3A</u> Sussex
GEORGIA	<u>6A7</u> Schoolcraft	<u>4A5A</u> Ross	<u>3A</u> Virginia Beach city
<u>3A4A</u> Banks	MINNESOTA	<u>4A5A</u> Vinton	WASHINGTON
<u>2A3A</u> Calhoun*	<u>6A7</u> Becker	<u>4A5A</u> Warren	<u>5C4G</u> Clallam
<u>3A4A</u> Catoosa	<u>6A7</u> Clay	OKLAHOMA	<u>5C4G</u> Island
<u>3A4A</u> Chattooga	<u>5A6A</u> Fillmore	<u>4A3A</u> Alfalfa	<u>5C4G</u> Kitsap
<u>2A3A</u> Coffee*	<u>6A7</u> Grant	<u>4A3A</u> Craig	<u>5B6B</u> Okanogan
<u>3A4A</u> Dade	<u>5A6A</u> Houston	<u>4A3A</u> Delaware	<u>5C4G</u> San Juan
<u>3A4A</u> Dawson	<u>6A7</u> Kanabec	<u>4A3A</u> Ellis	WEST VIRGINIA
<u>2A3A</u> Dougherty*	<u>6A7</u> Mille Lacs	<u>4A3A</u> Garfield	<u>4A5A</u> Doddridge
<u>2A3A</u> Early*	<u>6A7</u> Otter Tail	<u>4A3A</u> Grant	<u>4A5A</u> Fayette
<u>3A4A</u> Fannin	<u>6A7</u> Wilkin	<u>4A3A</u> Harper	<u>4A5A</u> Greenbrier
<u>3A4A</u> Floyd	<u>5A6A</u> Winona	<u>4A3A</u> Kay	<u>4A5A</u> Lewis
<u>3A4A</u> Franklin	MISSISSIPPI	<u>4A3A</u> Major	<u>4A5A</u> Nicholas
<u>3A4A</u> Gilmer	<u>2A3A</u> George*	<u>4A3A</u> Nowata	<u>4A5A</u> Raleigh
<u>3A4A</u> Gordon	MISSOURI	<u>4A3A</u> Osage	<u>4A5A</u> Summers
<u>3A4A</u> Habersham	<u>4A5A</u> Buchanan	<u>4A3A</u> Ottawa	<u>4A5A</u> Upshur
<u>3A4A</u> Hall	<u>4A5A</u> Caldwell	<u>4A3A</u> Washington	<u>4A5A</u> Webster
<u>3A4A</u> Lumpkin	<u>4A5A</u> Chariton	<u>4A3A</u> Woods	WISCONSIN
<u>3A4A</u> Murray	<u>4A5A</u> Clinton	<u>4A3A</u> Woodward	<u>5A6A</u> Adams
<u>3A4A</u> Pickens	<u>3A4A</u> Dunklin	OREGON	<u>6A7</u> Ashland

3A4A Rabun	3A4A Pemiscot	PENNSYLVANIA	6A7 Bayfield
3A4A Stephens	MONTANA	4A5A Adams	6A7 Burnett
2A3A Tift*	NEBRASKA	4A5A Berks	5A6A Calumet
3A4A Towns	NEVADA	5A6A Cameron	5A6A Columbia
3A4A Union	4B5B Carson City (city)	5A6A Clearfield	5A6A Crawford
3A4A Walker	4B5B Douglas	4A5A Cumberland	5A6A Dane
3A4A White	4B5B Esmeralda	4A5A Dauphin	5A6A Dodge
3A4A Whitfield	4B5B Lincoln	5A6A Elk	6A7 Douglas
2A3A Worth*	4B5B Lyon	4A5A Franklin	6A7 Florence
HAWAII	4B5B Mineral	4A5A Lancaster	5A6A Fond du Lac
IDAHO	4B5B Nye	4A5A Lebanon	6A7 Forest
ILLINOIS	NEW HAMPSHIRE	5A6A McKean	5A6A Grant
4A5A Calhoun	5A6A Merrimack	4A5A Perry	5A6A Green
4A5A Clark	NEW JERSEY	5A6A Potter	5A6A Green Lake
4A5A Coles	4A5A Mercer	5A6A Susquehanna	5A6A Iowa
4A5A Cumberland	NEW MEXICO	5A6A Tioga	6A7 Iron
4A5A Greene	4B5B Catron	5A6A Wayne	5A6A Jefferson
4A5A Jersey	3B4B Sierra	RHODE ISLAND	5A6A Juneau
INDIANA	5A6A Allegany	SOUTH CAROLINA	5A6A Kenosha
4A5A Bartholomew	5A6A Broome	2A3A Beaufort*	5A6A La Crosse
4A5A Clay	5A6A Cattaraugus	2A3A Jasper*	5A6A Lafayette
4A5A Decatur	5A6A Schoharie	SOUTH DAKOTA	6A7 Langlade
4A5A Fayette	5A6A Schuyler	5A6A Brule	6A7 Lincoln
4A5A Franklin	5A6A Steuben	5A6A Haakon	5A6A Milwaukee
4A5A Hendricks	5A6A Tompkins	5A6A Jones	5A6A Monroe
4A5A Johnson	5A6A Wyoming	5A6A Lyman	6A7 Oneida
4A5A Marion	NORTH CAROLINA	5A6A Stanley	5A6A Outagamie
4A5A Morgan	3A4A Alamance	TENNESSEE	5A6A Ozaukee
4A5A Owen	3A4A Alexander	3A4A Bedford	6A7 Price
4A5A Putnam	3A4A Bertie	3A4A Coffee	5A6A Racine
4A5A Rush	3A4A Caswell	3A4A Davidson	5A6A Richland
4A5A Shelby	3A4A Catawba	3A4A Decatur	5A6A Rock
4A5A Union	3A4A Chatham	3A4A Franklin	5A6A Sauk
4A5A Vigo	3A4A Cherokee	3A4A Gibson	6A7 Sawyer
IOWA	3A4A Clay	3A4A Giles	6A7 Taylor
5A6A Allamakee	3A4A Cleveland	3A4A Grundy	5A6A Vernon
5A6A Bremer	3A4A Davie	3A4A Hamilton	6A7 Vilas
5A6A Buchanan	3A4A Durham	3A4A Hickman	5A6A Walworth

5A6A Buena Vista	3A4A Forsyth	4A3A Lake	6A7 Washburn
5A6A Butler	3A4A Franklin	3A4A Lawrence	5A6A Washington
5A6A Calhoun	3A4A Gates	3A4A Lewis	5A6A Waukesha
5A6A Cherokee	3A4A Granville	3A4A Lincoln	5A6A Waushara
5A6A Chickasaw	3A4A Guilford	3A4A Marion	5A6A Winnebago
5A6A Clayton	3A4A Halifax	3A4A Marshall	WYOMING
5A6A Delaware	3A4A Harnett	3A4A Maury	5B6B Laramie
5A6A Fayette	3A4A Hertford	3A4A Moore	US TERRITORIES
5A6A Floyd	3A4A Iredell	3A4A Perry	AMERICAN SAMOA
5A6A Franklin	3A4A Lee	3A4A Rutherford	GUAM
5A6A Grundy	3A4A Lincoln	3A4A Wayne	NORTHERN MARIANA ISLANDS
5A6A Hamilton	4A5A Mitchell	3A4A Williamson	PUERTO RICO
5A6A Hardin	3A4A Nash	TEXAS	1A (all <u>except as follows:</u>)*
5A6A Howard	3A4A Northampton	1A2A Cameron*	<u>2B Barraquitas</u>
5A6A Humboldt	3A4A Orange	2A3A Dallas*	<u>2B Cayey</u>
5A6A Ida	3A4A Person	2A3A Ellis*	VIRGIN ISLANDS
5A6A Plymouth	3A4A Polk	1A2A Hidalgo*	
5A6A Pocahontas	3A4A Rockingham	2A3A Johnson*	
5A6A Sac	3A4A Rutherford	2A3A Navarro*	

R301.3 (IRC N1101.7.2) International climate zones. Climate zone definitions. ~~The climate zone for any location outside the United States shall be determined by applying Table R301.3(1) and then Table R301.3(2).~~ To determine the climate zones for locations not listed in this code, use the following information to determine climate zone numbers and letters.

Determine the thermal climate zone, 0–8, from Table R301.3(1) using the heating and cooling degree-days for the location. Determine the moisture zone (Marine, Dry or Humid):

- a. If monthly average temperature and precipitation data are available, use the Marine, Dry, and Humid definitions below to determine the moisture zone (C, B, or A).
- b. If annual average temperature information (including degree-days) and annual precipitation (i.e. annual mean) are available, use the following to determine the moisture zone:
 1. If thermal climate zone is 3 and $CDD50^{\circ}F \leq 4500$ ($CDD10^{\circ}C \leq 2500$), climate zone is Marine (3C).
 2. If thermal climate zone is 4 and $CDD50^{\circ}F \leq 2700$ ($CDD10^{\circ}C \leq 1500$), climate zone is Marine (4C).
 3. If thermal climate zone is 5 and $CDD50^{\circ}F \leq 1800$ ($CDD10^{\circ}C \leq 1000$), climate zone is Marine (5C).

Use the third criteria below for determining the Dry/Humid threshold if not Marine (C).
- c. If only degree-day information is available, use the following to determine the moisture zone:

1. If thermal climate zone is 3 and $CDD50^{\circ}F \leq 4500$ ($CDD10^{\circ}C \leq 2500$), climate zone is Marine (3C).

2. If thermal climate zone is 4 and $CDD50^{\circ}F \leq 2700$ ($CDD10^{\circ}C \leq 1500$), climate zone is Marine (4C).
3. If thermal climate zone is 5 and $CDD50^{\circ}F \leq 1800$ ($CDD10^{\circ}C \leq 1000$), climate zone is Marine (5C).

It is not possible to assign Dry/Humid splits in this case.
Marine (C) Zone Definition—Locations meeting all four of the following criteria:

a. Mean temperature of coldest month between $27^{\circ}F$ ($-3^{\circ}C$) and $65^{\circ}F$ ($18^{\circ}C$)

b. Warmest month mean $< 72^{\circ}F$ ($22^{\circ}C$)

c. At least four months with mean temperatures over $50^{\circ}F$ ($10^{\circ}C$)

d. Dry season in summer. The month with the heaviest precipitation in the cold season has at least three times as much precipitation as the month with the least precipitation in the rest of the year. The cold season is October through March in the Northern Hemisphere and April through September in the Southern Hemisphere.

Dry (B) Definition—Locations meeting the following criteria:

a. Not Marine (C)

b. If 70% or more of the precipitation, P, occurs during the high sun period, then the dry/humid threshold is: $P < 0.44 \times (T - 7) (I-P)P < 20.0 \times (T + 14) (SI)$

c. If between 30% and 70% of the precipitation, P, occurs during the high sun period, then the dry/humid threshold is: $P < 0.44 \times (T - 19.5) (I-P)P < 20.0 \times (T + 7) (SI)$

d. If 30% or less of the precipitation, P, occurs during the high sun period, then the dry/humid threshold is: $P < 0.44 \times (T - 32) (I-P)P < 20 \times T (SI)$ where: P = annual precipitation, in. (mm). T = annual mean temperature, $^{\circ}F$ ($^{\circ}C$). Summer or = April through September in the high sun Northern Hemisphere and October period through March in the Southern Hemisphere. Winter or = October through March in the Northern cold season Hemisphere and April through September in the Southern Hemisphere.
Humid (A) Definition—Locations that are not Marine (C) and not Dry

Revise as follows:

TABLE R301.3(1) [IRC N1101.7.2(1)]
INTERNATIONAL CLIMATE ZONE DEFINITIONS

MAJOR CLIMATE TYPE DEFINITIONS

<p>Marine (G) Definition—Locations meeting all four criteria:</p> <p>1. Mean temperature of coldest month between -3°C (27°F) and 18°C (65°F).</p> <p>2. Warmest month mean $< 22^{\circ}\text{C}$ (72°F).</p> <p>3. Not fewer than four months with mean temperatures over 10°C (50°F).</p> <p>4. Dry season in summer. The month with the heaviest precipitation in the cold season has not less than three times as much precipitation as the month with the least precipitation in the rest of the year. The cold season is October through March in the Northern Hemisphere and April through September in the Southern Hemisphere.</p>
<p>Dry (B) Definition—Locations meeting the following criteria:</p> <p>Not marine and $P_{\text{eff}} < 0.44 \times (T_{\text{F}} - 19.5)$ [$P_{\text{eff}} < 2.0 \times (T_{\text{C}} + 7)$ in SI units]</p> <p>where:</p> <p>P_{eff} = Annual precipitation in inches (cm)</p> <p>T = Annual mean temperature in $^{\circ}\text{F}$ ($^{\circ}\text{C}$)</p>
<p>Moist (A) Definition—Locations that are not marine and not dry.</p>
<p>Warm humid Definition—Moist (A) locations where either of the following wet bulb temperature conditions shall occur during the warmest six consecutive months of the year:</p> <p>1. 67°F (19.4°C) or higher for 3,000 or more hours.</p> <p>2. 73°F (22.8°C) or higher for 1,500 or more hours.</p>

For SI: $^{\circ}\text{C} = [(^{\circ}\text{F}) - 32]/1.8$, 1 inch = 2.54 cm.

TABLE R301.3(2.1) [IRC N1101.7.2(2.1)]
INTERNATIONAL CLIMATE ZONE DEFINITIONS

ZONE NUMBER	THERMAL CRITERIA	
	IP Units	SI Units
1	$9000 < \text{CDD}_{50}^{\circ}\text{F}$	$5000 < \text{CDD}_{10}^{\circ}\text{C}$
2	$6300 < \text{CDD}_{50}^{\circ}\text{F} \leq 9000$	$3500 < \text{CDD}_{10}^{\circ}\text{C} \leq 5000$ 6000
3A and 3B	$4500 < \text{CDD}_{50}^{\circ}\text{F} \leq 6300$ AND $\text{HDD}_{65}^{\circ}\text{F} \leq 5400$ 3600	$2500 < \text{CDD}_{10}^{\circ}\text{C} \leq 3500$ AND $\text{HDD}_{18}^{\circ}\text{C} \leq 3000$ 2000
4A and 4B	$\text{CDD}_{50}^{\circ}\text{F} \leq 4500$ 6300 AND $3600 < \text{HDD}_{65}^{\circ}\text{F} \leq 5400$	$\text{CDD}_{10}^{\circ}\text{C} \leq 2500$ 3500 AND $\text{HDD}_{18}^{\circ}\text{C} \leq 3000$
3G	$\text{HDD}_{65}^{\circ}\text{F} \leq 3600$	$\text{HDD}_{18}^{\circ}\text{C} \leq 2000$
4G	$3600 < \text{HDD}_{65}^{\circ}\text{F} \leq 5400$	$2000 < \text{HDD}_{18}^{\circ}\text{C} \leq 3000$
5	$\text{CDD}_{50}^{\circ}\text{F} < 6300$ AND $5400 < \text{HDD}_{65}^{\circ}\text{F} \leq 7200$	$\text{CDD}_{10}^{\circ}\text{C} < 3500$ AND $3000 < \text{HDD}_{18}^{\circ}\text{C} \leq 4000$
6	$7200 < \text{HDD}_{65}^{\circ}\text{F} \leq 9000$	$4000 < \text{HDD}_{18}^{\circ}\text{C} \leq 5000$
7	$9000 < \text{HDD}_{65}^{\circ}\text{F} \leq 12600$	$5000 < \text{HDD}_{18}^{\circ}\text{C} \leq 7000$
8	$12600 < \text{HDD}_{65}^{\circ}\text{F}$	$7000 < \text{HDD}_{18}^{\circ}\text{C}$

For SI: $^{\circ}\text{C} = [(^{\circ}\text{F}) - 32]/1.8$.

R301.4 (IRC N1101.8) Tropical climate zone. The tropical *climate zone* shall be defined as:

1. Hawaii, Puerto Rico, Guam, American Samoa, U.S. Virgin Islands, Commonwealth of Northern Mariana Islands; and
2. Islands in the area between the Tropic of Cancer and the Tropic of Capricorn.

Reason:

Reason:

Currently approximately 10% of the counties across the US have different different climate zones under the IECC and ASHRAE 90.1, ASHRAE 90.2, and the IgCC. This proposal updates the climate zones to correspond with the release of ASHRAE Standard 169-2013, which is referenced in both the 2018 IgCC and ASHRAE 90.1 and ASHRAE 90.2 Approximately 10% of the counties in the United States have a change in Climate Zone designation due to this change. ICC has a licensing agreement with ASHRAE to include the climate zone map, definitions and tables for consistency with ASHRAE Standard 169-2013.

This modification includes:

- The U.S. map as Figure R301.1 and U.S. county tables as Table R301.1 to be used in determining the climate zone for locations within the U.S.
- Updating county climate zone designations in Tables C301.1 and R301.1
- Updating the information in Tables C301.3(1) and R301.3(1) with an updated Climate Zone Definition, replacing these tables with text in Sections C301.3 and R301.3.
- Updating Tables C301.3(2) and R301.3(2) to include Climate Zone 0, and modify climate zones 1-4 for consistency across the IECC, IgCC and ASHRAE 90.1

Climate Zone 0 is a subset of the previous Climate Zone 1. Whereas the previous CZ 1 was all locations with more than 9,000 Cooling Degree Days, Climate Zone 1 now "tops out" at 10,800 Cooling Degree Days, and Climate Zone 0 is for those locations with more than 10,800 Cooling Degree Days. Cities in Climate Zone 0 include very hot locations such as Mumbai (Bombay), Jakarta and Abu Dhabi. There are no cities in the United States in Climate Zone 0; Miami and the islands of Hawaii are in Climate Zone 1.

The separation of Climate Zones 0 and 1 allows separate criteria for IECC to be developed that are more specific to the very hot regions with Climate Zone 0.

Because Climate Zone 0 is a subset of the previous Climate Zone 1, and the code does not currently have any criteria specific to climate zone 0, the following are typical editorial change that will result from the addition of Climate Zone 0.

Section or Table	Current Language	Proposed addition of Zero
TABLE R402.1.2 INSULATION AND FENESTRATION REQUIREMENTS BY COMPONENT _a	1	0-1
TABLE R402.1.2 INSULATION AND FENESTRATION REQUIREMENTS BY COMPONENT _a footnote b	Exception: In Climate Zones 1 through 3,	Exception: In Climate Zones 0 through 3,
R403.3.6 (3) Ducts buried within ceiling insulation.	In Climate Zones 1A, 2A and 3A, the	In Climate Zones 0A, 1A, 2A and 3A, the supply ducts

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>
(<http://www.iccsafe.org/cs/SEHPCAC/Pages/default.aspx>)

Proposal # 5824

CE36-19 Part II

CE37-19 Part I

PART I — IECC: Part I: C303.1

IECC: Part II: R303.1(N1101.10)

PART II — IECC: R303.1 (IRC N1101.10)

Proponent: donald sivigny, State of MN, 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- COMMERCIAL COMMITTEE. PART II WILL BE HEARD BY THE IECC-RESIDENTIAL COMMITTEE. SEE THE TENTATIVE HEARING ORDER FOR THESE COMMITTEES.

2018 International Energy Conservation Code

C303.1 Identification. Materials, systems, and equipment shall be identified in a manner that will allow a determination of compliance with the applicable provisions of this code. Materials used shall be:

1. Listed for the intended use;
2. Installed in accordance with the manufacturer's installation instructions; and
3. Installed by an installer who is certified by a manufacturer to install that specific product, if such certification is required by the product manufacturer.

Proposal # 5762

CE37-19 Part I

CE37-19 Part II

IECC: R303.1 (IRC N1101.10)

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:

R303.1 (IRC N1101.10) Identification. Materials, systems, and equipment shall be identified in a manner that will allow a determination of compliance with the applicable provisions of this code. Materials used shall be:

1. Listed for the intended use.
2. Installed in accordance with the manufacturer's installation instructions, and
3. Installed by an installer who is certified by a manufacturer to install that specific product, if such certification is required by the product manufacturer

Reason: This Section of the code is amended to modify section R303.1 by adding language to make sure that sufficient information exists to ensure that materials and equipment used are designed for that intended use, installed according to the manufacturer's installation instructions, and are installed by an individual certified to install the product as required by the manufacturer, if the certification exists for that particular product. The manufacturer's installation instructions are required because many product manufacturers have specific instructions about how their products must be installed to ensure their performance. Requiring the use of the instructions will help ensure the product performs as the manufacturer intended. Some products require installers to pass a certification test to ensure that the product is installed according to the manufacturer's specifications. Use of a certified installer, if such certification exists for a certain product, will help ensure the product performs as the manufacturer intended. The permit Applicant can submit this information in a number of ways. On the plans, spec sheets, schedules, (such as window schedules and equipment schedules), or any other way deemed acceptable by the code official, as each applies to a specific portion or component of the Building.

Cost Impact: The code change proposal will not increase or decrease the cost of construction. This proposal will save money by requiring qualified and trained individuals to install certain products in accordance with manufacturers specs and certifications if required. Doing the job right the first time is a money saver. Not knowing how to do it and doing it wrong will cost money.

Proposal # 5126

CE37-19 Part II

CE38-19

IECC: C303.1.3, TABLE C303.1.3(2)

Proponent: Kurt Roeper, representing Steel Door Institute (kurt.roeper@assaabloy.com)

2018 International Energy Conservation Code

Revise as follows:

C303.1.3 Fenestration product rating. *U*-factors of fenestration products shall be determined as follows:

1. For windows, doors and skylights, *U*-factor ratings shall be determined in accordance with NFRC 100.
2. Where required for garage doors and rolling doors, *U*-factor ratings 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 a default *U*-factor from Table C303.1.3(1) or C303.1.3(2). The *solar heat gain coefficient* (SHGC) and *visible transmittance* (VT) of glazed fenestration products (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 or VT shall be assigned a default SHGC or VT from Table C303.1.3(3).

TABLE C303.1.3(2)
DEFAULT OPAQUE DOOR *U*-FACTORS

DOOR TYPE	OPAQUE <i>U</i> -FACTOR
Uninsulated Metal	1.20 <u>0.60</u>
Insulated Metal (Rolling)	0.90
Insulated Metal (Other)	0.60 <u>0.42</u>
Wood	0.50
Insulated, nonmetal edge, max 45% glazing, any glazing double pane	0.35

Reason: The existing default values are not reflective of product performance data. The proposed default values are *worst case* values derived from testing 26 specimens manufactured by 11 unique steel door manufacturers. A certified test report from an accredited, independent laboratory is appended to this proposal. Testing was conducted in accordance with:

ASTM C1199-09 *Standard Test Method for Measuring the Steady-State Thermal Transmittance of Fenestration Systems Using Hot Box Methods*

ASTM C1365 – 05 *Standard Test Method for Thermal Performance of Building Materials and Envelope Assemblies by Means of a Hot Box Apparatus*

ASTM E1423 – 06 *Standard Practice for Determining Steady State Thermal Transmittance of Fenestration Systems*

Section 303.1.3 unchanged – see table C303.1.3(2) for proposed change to default values

Cost Impact: The code change proposal will not increase or decrease the cost of construction
The proposed change to the default values does not impact the cost of construction, it only provides more accurate - worst case - assigned values.

Proposal # 5483

CE38-19

CE39-19

IECC: SECTION C202(New), C303.1.3, C402.4.2, C402.4.2.2, Chapter 6CE (New)

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

2018 International Energy Conservation Code

Revise as follows:

SECTION C202 GENERAL DEFINITIONS

Add new definition as follows:

VISIBLE TRANSMITTANCE, ANNUAL [VT_{annual}] The ratio of visible light entering the space through the fenestration product assembly to the incident visible light during the course of a year, which includes the effects of glazing material, frame, and light well or tubular conduit, and is expressed as a number between 0 and 1.

Revise as follows:

C303.1.3 Fenestration product rating. *U*-factors of fenestration products shall be determined as follows:

1. For windows, doors and skylights, *U*-factor ratings shall be determined in accordance with NFRC 100.
2. Where required for garage doors and rolling doors, *U*-factor ratings 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 a default *U*-factor from Table C303.1.3(1) or C303.1.3(2). The *solar heat gain coefficient* (SHGC) and *visible transmittance* (VT) of glazed fenestration products (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 or VT shall be assigned a default SHGC or VT from Table C303.1.3(3). For Tubular Daylighting Devices, VT_{annual} shall be measured and rated in accordance with NFRC 203.

C402.4.2 Minimum skylight fenestration area. In an enclosed space greater than 2,500 square feet (232 m²) in floor area, directly under a roof with not less than 75 percent of the ceiling area with a ceiling height greater than 15 feet (4572 mm), and used as an office, lobby, atrium, concourse, corridor, storage space, gymnasium/exercise center, convention center, automotive service area, space where manufacturing occurs, nonrefrigerated warehouse, retail store, distribution/sorting area, transportation depot or workshop, the total *toplit daylight zone* shall be not less than half the floor area and shall provide one of the following:

1. A minimum skylight area to *toplit daylight zone* of not less than 3 percent where all skylights have a VT of not less than 0.40, or VT_{annual} of not less than 0.26, as determined in accordance with Section C303.1.3.
2. A minimum skylight effective aperture ~~of not less than 1 percent,~~ determined in accordance with Equation 4-4 -

$$\text{Skylight Effective Aperture} = \frac{0.85 \times \text{Skylight Area} \times \text{Skylight VT} \times \text{WF}}{\text{Toplit Zone}}$$

of:

1. Not less than 1 percent, using a skylight's VT rating; or
2. Not less than 0.66 percent using a Tubular Daylighting Device's VT_{annual} rating.

(Equation 4-4)

where:

Skylight area = Total fenestration area of skylights.

Skylight VT = Area weighted average visible transmittance of skylights.

WF = Area weighted average well factor, where well factor is 0.9 if light well depth is less than 2 feet (610 mm), or 0.7 if light well depth is 2 feet (610 mm) or greater, or 1.0 for Tubular Daylighting Devices with VT_{annual} ratings.

Light well depth = Measure vertically from the underside of the lowest point of the skylight glazing to the ceiling plane under the skylight.

Exception: Skylights above *daylight zones* of enclosed spaces are not required in:

1. Buildings in *Climate Zones* 6 through 8.
2. Spaces where the designed *general lighting* power densities are less than 0.5 W/ft² (5.4 W/m²).
3. Areas where it is documented that existing structures or natural objects block direct beam sunlight on not less than half of the roof over the enclosed area for more than 1,500 daytime hours per year between 8 a.m. and 4 p.m.
4. Spaces where the *daylight zone* under rooftop monitors is greater than 50 percent of the enclosed space floor area.
5. Spaces where the total area minus the area of sidelight *daylight zones* is less than 2,500 square feet (232 m²), and where the lighting is controlled in accordance with Section C405.2.3.

C402.4.2.2 Haze factor. Skylights in office, storage, automotive service, manufacturing, nonrefrigerated warehouse, retail store and distribution/sorting area spaces shall have a glazing material or diffuser with a haze factor greater than 90 percent when tested in accordance with ASTM D1003.

Exception: Skylights and tubular daylighting devices designed and installed to exclude direct sunlight entering the occupied space by the use of fixed or automated baffles ~~or~~ the geometry of skylight and light well, or the use of optical diffuser components.

Add new standard(s) as follows:

NFRC

National Fenestration Rating
Council, Inc.
6305 Ivy Lane, Suite 140
Greenbelt MD 20770

203--2017: Procedure for Determining Translucent Fenestration Product Visible Transmittance at Normal Incidence

Reason: The IECC code changes contained in the “IECC C402 Updates to Incorporate NFRC203 VT_{annual} Equivalencies for Tubular Daylighting Devices (TDDs)” document provides recommended additions and edits that will allow the 2021 code language to remain consistent with new fenestration rating standards. The proposed changes incorporate industry-vetted code and Visible Transmittance (VT) rating protocol language that applies necessary equivalency factors for the National Fenestration Rating Council’s new NFRC 203 VT_{annual} Rating Protocol for Tubular Daylighting Devices (TDDs) as an alternative code-compliance option to the NFRC 200/202 VT (VT_{normal}) rating that is currently used for determining Minimum Skylight Fenestration Area requirements for conventional skylight products.

The traditional NFRC 200/202 Visible Transmittance rating procedure, rates the Visible Transmittance of conventional skylights using a single, direct-normal incidence angle condition, and represents a skylight’s VT for light that is “normal” (i.e. perpendicular) to the skylight’s surface. As a result, it does not account for the skylight’s effective system transmittance under the wide range of lower, incident sunlight angles that actually strike the skylight’s dome surface over the course of a year. To address this, the new NFRC 203 protocol applies enhanced physical Visible Transmittance testing of a TDD/skylight product using 18 precisely-controlled incidence angles, and measures/rates a TDD/skylight product’s functional, annualized visible light transmittance characteristics accounting for the product’s roof-top dome optics, light shaft (or “well” as defined in Code Section C402.4.2), and interior ceiling diffuser and/or aperture elements. It is also important to note that NFRC 203 is the only rating standard that is used for measuring and rating the Visible Transmittance of the TDD fenestration product category.

The code language additions contained in this code proposal, provide the necessary definitions and applicable VT conversion factors that relate a conventional skylight’s NFRC 202 direct-normal (VT_{normal}) rating to the functional VT_{annual} performance as determined using the NFRC 203 rating protocol, and enable the new NFRC 203 ratings to be used when determining a TDD’s Skylight Effective Aperture value using Equation 4-4 in code section C402.4.2. Also, since the NFRC 203 Rating Protocol tests the TDD/Skylight in its entirety, including a default 3-foot long tube run (or “well”), all resulting NFRC 203 VT_{annual} Ratings include the TDD’s well factor in the Product’s Visible Transmittance Data and Rating. As such, no further Well Factor (WF) adjustment is warranted, and a well factor of 1.0 should be applied in Equation 4-4.

The intent of applying the TDDs to the exception in code section C402.4.2.2, when optical diffuser components are present, is based on the defined scope of ASTM D1003.

Bibliography: NFRC 203-2017 [E0A1] Procedure for Determining Visible Transmittance of Tubular Daylighting Devices

NFRC 202-2017 [E0A0] Procedure for Determining Translucent Fenestration Product Visible Transmittance at Normal Incidence

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

The proposed code edits/additions represent a cost-neutral change to the IECC. They merely provide the necessary definitions and conversion factors that allow the new, more rigorous NFRC 203 product ratings to be applied to Code Section C402.4.2 with equivalency to the existing conventional NFRC 200/202 skylight ratings, and are expected to increase the overall usability of the standard. The proposed code changes do not change the stringency of the standard, and as such, they do not impact the resulting energy savings or the associated cost of compliance.

Staff Analysis: A review of the standard proposed for inclusion in the code, NFRC 203-2017, 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.

Analysis: A review of the standard proposed for inclusion in the code, NFRC 203, 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.

CE40-19 Part I

PART I — IECC: Part I: C303.1.2
IECC: Part II: R303.1.2.

PART II — IECC: R303.1.2 (IRC N1101.10.2)

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

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

2018 International Energy Conservation Code

SECTION C303 MATERIALS, SYSTEMS AND EQUIPMENT

C303.1.2 Insulation mark installation. Insulating materials shall be installed such that the manufacturer's *R*-value mark is readily observable upon inspection. . For insulation materials that are installed without an observable manufacturer's R-value mark, such as blown or draped products, an insulation certificate complying with Section C303.1.1 shall be left immediately after installation by the installer, in a conspicuous location within the building, to certify the installed R-value of the insulation material.

Proposal # 4802

CE40-19 Part I

CE40-19 Part II

IECC: R303.1.2 (IRC N1101.10.2)

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

2018 International Energy Conservation Code

Revise as follows:

R303.1.2 (IRC N1101.10.2) Insulation mark installation. Insulating materials shall be installed such that the manufacturer's *R*-value mark is readily observable at inspection. For insulation materials that are installed without an observable manufacturer's *R*-value mark, such as blown or draped products, an insulation certificate complying with Section R303.1.1 shall be left immediately after installation by the installer, in a conspicuous location within the building, to certify the installed *R*-value of the insulation material.

Reason: More and more insulation products are being developed and installed that do not come with a manufacturer's *R*-value marking. Primarily these are blown insulation materials that are dependent on the density of the blown product installation to ensure proper *R*-value of the material. Many materials can be blown at different densities to achieve different *R*-values and there is no visible way to verify if the required or specified *R*-value has been achieved. In lieu of mandating density quality assurance checks on the installation of blown insulation material, a requirement that the installer of the material certify the *R*-value of the installation will allow the Code Official, Energy Rater, third party inspection agency, HVAC contractor, and others who must use the *R*-value for calculations or verification of the code, to be satisfied that what is installed actually meets the *R*-value requirements.

Being able to rely on a document that certifies the *R*-value of the installed material that is not labeled will take pressure of the code official to document that the *R*-value installed matches the submitted and approved documentation for obtaining the building permit. Required Manual J and S HVAC design reports are an example of document that fundamentally rely on the proper installation of the *R*-values that have been specified for the dwelling. If the *R*-value is less or more than that used in the HVAC design the mechanical heating and cooling equipment could be over or undersized impacting the energy performance of the home. Lastly, a certified document helps code officials have confidence that others that are using the *R*-value of the home to demonstrate compliance are accurately representing *R*-values that are installed in the home.

Other insulation materials that often are installed without observable *R*-value Marks include vinyl draped fiberglass blankets or fiberglass batt material that is marked with a color that blends into the color of the fiberglass. In addition, most batt material is marked in one location and on one side of the material so when it is cut to fit in a rim joist, for example, it is not visible to the inspector.

In order to right size HVAC systems, create an accurate computer model for the EIR or simulated performance path, and/or properly verify code required *R*-values, "observable" should be enforced consistently and inspectors should not have to search for or question what they are looking at. A certificate that certifies the installed materials *R*-value per component left at the time of the install rather than just at final will solve this issue.

Cost Impact: The code change proposal will not increase or decrease the cost of construction. Cost of construction should not increase as documentation of the installation is already required. This proposal clarifies that the document must be left at the time of the installation (rough stage of construction) as well as when attic blow or other secondary trips are made or needed.

Proposal # 5799

CE40-19 Part II

CE41-19

IECC: C401.2, C401.2.1 (New), C401.2.2 (New), C402.1, C407.2, C407.3

Proponent: David Collins, representing SEHPCAC (SEHPCAC@iccsafe.org); David Collins, The Preview Group, Inc., representing The American Institute of Architects (dcollins@preview-group.com)

2018 International Energy Conservation Code

Revise as follows:

C401.2 Application. Commercial buildings shall comply with C401.2.1 or C401.2.2. ~~one of the following:~~

- ~~1. The requirements of ANSI/ASHRAE/IESNA 90.1.~~
- ~~2. The requirements of Sections C402 through C405 and C408. In addition, commercial buildings shall comply with Section C406 and tenant spaces shall comply with Section C406.1.1.~~
- ~~3. The requirements of Sections C402.5, C403.2, C403.3 through C403.3.2, C403.4 through C403.4.2.3, C403.5.5, C403.7, C403.8.1 through C403.8.4, C403.10.1 through C403.10.3, C403.11, C403.12, C404, C405, C407 and C408. The building energy cost shall be equal to or less than 85 percent of the standard reference design building.~~

Add new text as follows:

C401.2.1 International Energy Conservation Code. Commercial buildings shall comply with one of the following:

1. Prescriptive Compliance. The Prescriptive Compliance Option requires compliance with Sections C402 through C406, and C408
2. Total Building Performance. The Total Building Performance Option requires compliance with Section C407.

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

C401.2.2 ASHRAE 90.1. Commercial buildings shall comply with the requirements of ANSI/ASHRAE/IESNA 90.1.

Revise as follows:

C402.1 General (Prescriptive). Building thermal envelope assemblies for buildings that are intended to comply with the code on a prescriptive basis in accordance with the compliance path described in Item 2 ~~of 1 of~~ Section ~~C401.2~~ C401.2.1, shall comply with the following:

1. The opaque portions of the building thermal envelope shall comply with the specific insulation requirements of Section C402.2 and the thermal requirements of either the *R*-value-based method of Section C402.1.3; the *U*-, *C*- and *F*-factor-based method of Section C402.1.4; or the component performance alternative of Section C402.1.5.
2. Roof solar reflectance and thermal emittance shall comply with Section C402.3.
3. Fenestration in building envelope assemblies shall comply with Section C402.4.
4. Air leakage of building envelope assemblies shall comply with Section C402.5.

Alternatively, where buildings have a vertical fenestration area or skylight area exceeding that allowed in Section C402.4, the building and building thermal envelope shall comply with Section C401.2, Item 1 or Section C401.2, Item 3.

Walk-in coolers, walk-in freezers, refrigerated warehouse coolers and refrigerated warehouse freezers shall comply with Section C403.10.1 or C403.10.2.

C407.2 Mandatory requirements. Compliance with this section requires compliance with Sections C402.5, C403.2, C403.3 through C403.3.2, C403.4 through C403.4.2.3, C403.5.5, C403.7, C403.8.1 through C403.8.4, C403.10.1 through C403.10.3, C403.11, C403.12, C404 and C405, C405.1, C405.2, C405.4 through C405.9, and C408.

C407.3 Performance-based compliance. Compliance based on total building performance requires that a proposed building (*proposed design*) be shown to have an annual energy cost that is less than or equal to 85% of 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 Price and Expenditure Report*. *Code officials* shall be permitted to require time-of-use pricing in energy cost calculations. The reduction in energy cost of the proposed design associated with *on-site renewable energy* shall be not more than 5 percent of the total energy cost. The amount of renewable energy purchased from off-site sources shall be the same in the *standard reference design* and the *proposed design*.

Exception: Jurisdictions that require site energy (1 kWh = 3413 Btu) rather than energy cost as the metric of comparison.

Reason: No technical changes are intended. No advantage to any proprietary interests governed by the code is intended. The intent is to strictly make the IECC more understandable and easier to use, as explained below.

Currently mandatory provisions are referenced in Section C401.2 (3) and listed again in a conflicting list within Section C407. Eliminating the C401.2 (3) list leaves mandatory elements singularly listed within C407 which resolves conflicts.

Naming the compliance options (prescriptive, performance) formalizes the way in which the paths are typically identified. Using the word "option" reinforces that it is the designer's choice as to which path is followed.

This change also further clarifies that one cannot combine the IECC and ASHRAE compliance paths on a given project.

In creating the singular list of mandatory requirements in C407, it also clarifies that C405.3 Lighting Power Densities is Prescriptive, and labeled as such, while C405.1, C405.2, C405.4, C405.6 and C405.7 are labeled mandatory. C408 which was listed in C401.2 is now included in C407.

This proposal also relocates the 85 percent requirement from Section C401.2 (3) to Section C407. Making this change puts all of the performance path targets in C407, either directly or by reference.

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>
(<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 change does not increase or decrease code provisions nor impact construction methods. It clarifies language and provisions already contained in the code.

Proposal # 4180

CE41-19

CE42-19 Part I

PART I — IECC: C401.2, SECTION C407, C407.1, C407.2, C407.3, Table C407.2 (New), C102.1.1, C402.1, C402.2, C402.4, C402.5, C403.2, C403.2.1, C403.2.2, C403.3, C403.3.1, C403.3.2, C403.3.2.1, C403.4, C403.4.1, C403.4.1.1, C403.4.1.2, C403.4.1.3, C403.4.1.4, C403.4.1.5, C403.4.2, C403.4.2.1, C403.4.2.2, C403.4.2.3, C403.4.3, C403.5, C403.5.5, C403.7.1, C403.7.2, C403.7.3, C403.7.4, C403.7.5, C403.7.6, C403.7.7, C403.8.1, C403.8.2, C403.8.3, C403.8.4, C403.10.1, C403.10.2, C403.10.2.1, C403.10.3, C403.11.1, C403.11.2, C403.11.2.1, C403.11.2.2, C403.11.2.3, C403.11.3, C403.11.3.1, C403.12, SECTION C404, C404.9, C404.10, C405.1, C405.2, C405.3, C405.4, C405.4.3, C405.5, C405.6, C405.7

PART II — IECC: R102.1.1 (IRC N1101.4), R401.3 (IRC N1101.14), R402.1 (IRC N1102.1), R402.2 (IRC N1102.2), R402.3 (IRC N1102.3), R402.4 (IRC N1102.4), R402.5 (IRC N1102.5), R403.1 (IRC N1103.1), R403.1.2 (IRC N1103.1.2), R403.3.1 (IRC N1103.3.1), R403.3.2 (IRC N1103.3.2), R403.3.3 (IRC N1103.3.3), R403.3.4 (IRC N1103.3.4), R403.3.5 (IRC N1103.3.5), R403.4 (IRC N1103.4), R403.5.1 (IRC N1103.5.1), R403.5.3 (IRC N1103.5.3), R403.6 (IRC N1103.6), R403.7 (IRC N1103.7), R403.8 (IRC N1103.8), R403.9 (IRC N1103.9), R403.10 (IRC N1103.10), R403.11 (IRC N1103.11), R404.1 (IRC N1104.1), R404.1.1 (IRC N1104.1.1) R405 (N1105), R405.2 (IRC N1105.2), TABLE R405.2 (IRC N1105.2) (New), R405.3 (IRC N1105.3), R406 (IRC N1106), R406.2 (IRC N1106.2), TABLE R406.2 (IRC N1106.2) (New), R406.3 (IRC N1106.3), R406.3.1 (IRC N1105.3.1), R406.3.2 (IRC N1106.3.2), TABLE R406.4 (IRC N1106.4)

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

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

2018 International Energy Conservation Code

Revise as follows:

C401.2 Application. Commercial buildings shall comply with one of the following:

1. The requirements of ANSI/ASHRAE/IESNA 90.1.
2. The requirements of Sections C402 through C405 and C408. In addition, commercial buildings shall comply with Section C406 and tenant spaces shall comply with Section C406.1.1.
3. The requirements of Section C407. ~~Sections C402.5, C403.2, C403.3 through C403.3.2, C403.4 through C403.4.2.3, C403.5.5, C403.7, C403.8.1 through C403.8.4, C403.10.1 through C403.10.3, C403.11, C403.12, C404, C405, C407 and C408. The building energy cost shall be equal to or less than 85 percent of the standard reference design building.~~

SECTION C407 TOTAL BUILDING PERFORMANCE

C407.1 Scope. This section establishes criteria for compliance using total building performance. The following systems and loads shall be included in determining the total building performance: heating systems, cooling systems, service water heating, fan systems, lighting power, receptacle loads and process loads.

Exception: Energy used to recharge or refuel vehicles that are used for on-road and off-site transportation purposes.

Delete without substitution:

~~**C407.2 Mandatory requirements.** Compliance with this section requires compliance with Sections C402.5, C403.2, C403.3 through C403.3.2, C403.4 through C403.4.2.3, C403.5.5, C403.7, C403.8.1 through C403.8.4, C403.10.1 through C403.10.3, C403.11, C403.12, C404 and C405.~~

Revise as follows:

~~**C407.3**~~ **C407.2 Performance-based compliance.** Compliance based on total building performance requires that a *proposed building (proposed design)* be shown to have an design meet all of the following:

1. The requirements of the sections indicated within Table C407.2
2. An annual energy cost that is less than or equal to 85 percent 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 Price and Expenditure Report*. *Code officials* shall be permitted to require time-of-use pricing in energy cost calculations. The reduction in energy cost of the proposed design associated with *on-site renewable energy* shall be not more than 5 percent of the total energy cost. The amount of renewable energy purchased from off-site sources shall be the same in the *standard reference design* and the *proposed design*.

Exception: Jurisdictions that require site energy (1 kWh = 3413 Btu) rather than energy cost as the metric of comparison.

Add new text as follows:

Table C407.2
Requirements for Total Building Performance

Section ^a	Title
<u>Envelope</u>	
C402.5	<u>Air Leakage-Thermal Envelope</u>
<u>Mechanical</u>	
C403.2	<u>System Design</u>
C403.3, except sections C403.3.3 and C403.3.4	<u>Heating and Cooling Equipment Efficiencies</u>
C403.4, except sections C403.4.3 C403.4.4, and C403.4.5	<u>Heating and Cooling System Controls</u>
C403.5.5	<u>Economizer Fault Detection and Diagnostics (FDD)</u>
C403.7	<u>Ventilation and Exhaust Systems</u>
C403.8, except sections C403.8.5 and C403.8.5.1	<u>Fan and Fan Controls</u>
C403.10, except section C403.10.4	<u>Walk-in coolers, Walk-in Freezers, Refrigerated Warehouse Coolers and Refrigerated Warehouse Freezers</u>
C403.11	<u>Construction of HVAC system elements</u>
C403.12	<u>Mechanical systems located outside of the building thermal envelope</u>
C404	<u>Service Water Heating</u>
C405, except section C405.3	<u>Electrical Power and Lighting Systems</u>
C408	<u>System Commissioning</u>

^a Reference to a code section includes all the relative subsections except as indicated in the table.

Revise as follows:

C102.1.1 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 as exceeding~~ 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 Table C407.2~~ shall be met.

C402.1 General (Prescriptive). Building thermal envelope assemblies for buildings that are intended to comply with the code on a prescriptive basis in accordance with the compliance path described in Item 2 of Section C401.2, shall comply with the following:

1. The opaque portions of the building thermal envelope shall comply with the specific insulation requirements of Section C402.2 and the thermal requirements of either the *R*-value-based method of Section C402.1.3; the *U*-, *C*- and *F*-factor-based method of Section C402.1.4; or the component performance alternative of Section C402.1.5.
2. Roof solar reflectance and thermal emittance shall comply with Section C402.3.
3. Fenestration in building envelope assemblies shall comply with Section C402.4.
4. Air leakage of building envelope assemblies shall comply with Section C402.5.

Alternatively, where buildings have a vertical fenestration area or skylight area exceeding that allowed in Section C402.4, the building and building thermal envelope shall comply with Section C401.2, Item 1 or Section C401.2, Item 3.

Walk-in coolers, walk-in freezers, refrigerated warehouse coolers and refrigerated warehouse freezers shall comply with Section C403.10.1 or C403.10.2.

C402.2 Specific building thermal envelope insulation requirements (Prescriptive). Insulation in building thermal envelope opaque assemblies shall comply with Sections C402.2.1 through C402.2.7 and Table C402.1.3.

C402.4 Fenestration (Prescriptive). Fenestration shall comply with Sections C402.4.1 through C402.4.5 and Table C402.4. Daylight responsive controls shall comply with this section and Section C405.2.3.1.

C402.5 Air leakage—thermal envelope (Mandatory). The *thermal envelope* of buildings shall comply with Sections C402.5.1 through C402.5.8, or the building *thermal envelope* shall be tested in accordance with ASTM E 779 at a pressure differential of 0.3 inch water gauge (75 Pa) or an equivalent method approved by the code official and deemed to comply with the provisions of this section when the tested air leakage rate of the building thermal envelope is not greater than 0.40 cfm/ft² (2.0 L/s • m²). Where compliance is based on such testing, the building shall also comply with Sections C402.5.5, C402.5.6 and C402.5.7.

C403.2 System design (Mandatory). Mechanical systems shall be designed to comply with Sections C403.2.1 and C403.2.2. Where elements of a building’s mechanical systems are addressed in Sections C403.3 through C403.12, such elements shall comply with the applicable provisions of those sections.

C403.2.1 Zone isolation required (Mandatory). HVAC systems serving *zones* that are over 25,000 square feet (2323 m²) in floor area or that span more than one floor and are designed to operate or be occupied nonsimultaneously shall be divided into isolation areas. Each isolation area shall be equipped with *isolation devices* and controls configured to automatically shut off the supply of conditioned air and outdoor air to and exhaust air from the isolation area. Each isolation area shall be controlled independently by a device meeting the requirements of Section C403.4.2.2. Central systems and plants shall be provided with controls and devices that will allow system and equipment operation for any length of time while serving only the smallest isolation

area served by the system or plant.

Exceptions:

1. Exhaust air and outdoor air connections to isolation areas where the fan system to which they connect is not greater than 5,000 cfm (2360 L/s).
2. Exhaust airflow from a single isolation area of less than 10 percent of the design airflow of the exhaust system to which it connects.
3. Isolation areas intended to operate continuously or intended to be inoperative only when all other isolation areas in a *zone* are inoperative.

C403.2.2 Ventilation (Mandatory). Ventilation, either natural or mechanical, shall be provided in accordance with Chapter 4 of the International Mechanical Code. Where mechanical ventilation is provided, the system shall provide the capability to reduce the outdoor air supply to the minimum required by Chapter 4 of the International Mechanical Code.

C403.3 Heating and cooling equipment efficiencies (Mandatory). Heating and cooling equipment installed in mechanical systems shall be sized in accordance with Section C403.3.1 and shall be not less efficient in the use of energy than as specified in Section C403.3.2.

C403.3.1 Equipment sizing (Mandatory). The output capacity of heating and cooling equipment shall be not greater than that of the smallest available equipment size that exceeds the loads calculated in accordance with Section C403.1.1. A single piece of equipment providing both heating and cooling shall satisfy this provision for one function with the capacity for the other function as small as possible, within available equipment options.

Exceptions:

1. Required standby equipment and systems provided with controls and devices that allow such systems or equipment to operate automatically only when the primary equipment is not operating.
2. Multiple units of the same equipment type with combined capacities exceeding the design load and provided with controls that are configured to sequence the operation of each unit based on load.

C403.3.2 HVAC equipment performance requirements (Mandatory). Equipment shall meet the minimum efficiency requirements of Tables C403.3.2(1) through C403.3.2(9) when tested and rated in accordance with the applicable test procedure. Plate-type liquid-to-liquid heat exchangers shall meet the minimum requirements of Table C403.3.2(10). The efficiency shall be verified through certification under an approved certification program or, where a certification program does not exist, the equipment efficiency ratings shall be supported by data furnished by the manufacturer. Where multiple rating conditions or performance requirements are provided, the equipment shall satisfy all stated requirements. Where components, such as indoor or outdoor coils, from different manufacturers are used, calculations and supporting data shall be furnished by the designer that demonstrates that the combined efficiency of the specified components meets the requirements herein.

C403.3.2.1 Water-cooled centrifugal chilling packages (Mandatory). Equipment not designed for operation at AHRI Standard 550/590 test conditions of 44°F (7°C) leaving chilled-water temperature and 2.4 gpm/ton evaporator fluid flow and 85°F (29°C) entering condenser water temperature with 3 gpm/ton (0.054 l/s • kW) condenser water flow shall have maximum full-load kW/ton (FL) and part-load ratings requirements adjusted using Equations 4-6 and 4-7.

$FL_{adj} = FL / K_{adj}$

$FL_{adj} = FL / K_{adj}$

(Equation 4-6)

$$PLV_{adj} = IPLV / K_{adj}$$

$$PLV_{adj} = IPLV / K_{adj}$$

(Equation 4-7)

where:

$$K_{adj} = A \times B$$

FL = Full-load kW/ton value as specified in Table C403.3.2(7).

FL_{adj} = Maximum full-load kW/ton rating, adjusted for nonstandard conditions.

$IPLV$ = Value as specified in Table C403.3.2(7).

PLV_{adj} = Maximum $NPLV$ rating, adjusted for nonstandard conditions.

$$A = 0.00000014592 \times (LIFT)^4 + 0.0000346496 \times (LIFT)^3 + 0.00314196 \times (LIFT)^2 - 0.147199 \times (LIFT) + 3.9302$$

$$B = 0.0015 \times L_{vg}E_{vap} + 0.934$$

$$LIFT = L_{vg}Cond - L_{vg}E_{vap}$$

$L_{vg}Cond$ = Full-load condenser leaving fluid temperature (°F).

$L_{vg}Evap$ = Full-load evaporator leaving temperature (°F).

The FL_{adj} and PLV_{adj} values are only applicable for centrifugal chillers meeting all of the following full-load design ranges:

1. Minimum evaporator leaving temperature: 36°F.
2. Maximum condenser leaving temperature: 115°F.
3. 20°F ≤ LIFT ≤ 80°F.

C403.4 Heating and cooling system controls (Mandatory). Each heating and cooling system shall be provided with controls in accordance with Sections C403.4.1 through C403.4.5.

C403.4.1 Thermostatic controls (Mandatory). The supply of heating and cooling energy to each *zone* shall be controlled by individual thermostatic controls capable of responding to temperature within the *zone*. Where humidification or dehumidification or both is provided, not fewer than one humidity control device shall be provided for each humidity control system.

Exception: Independent perimeter systems that are designed to offset only building envelope heat losses, gains or both serving one or more perimeter *zones* also served by an interior system provided that both of the following conditions are met:

1. The perimeter system includes not fewer than one thermostatic control *zone* for each building exposure having exterior walls facing only one orientation (within ± 45 degrees) (0.8 rad) for more than 50 contiguous feet (15 240 mm).
2. The perimeter system heating and cooling supply is controlled by thermostats located within the *zones* served by the system.

C403.4.1.1 Heat pump supplementary heat (Mandatory). Heat pumps having supplementary electric resistance heat shall have controls that, except during defrost, prevent supplementary heat operation where the heat pump can provide the heating load.

C403.4.1.2 Deadband (Mandatory). Where used to control both heating and cooling, *zone* thermostatic controls shall be configured to provide a temperature range or deadband of not less than 5°F (2.8°C) within which the supply of heating and cooling energy to the *zone* is shut off or reduced to a minimum.

Exceptions:

1. Thermostats requiring manual changeover between heating and cooling modes.
2. Occupancies or applications requiring precision in indoor temperature control as *approved* by the *code official*.

C403.4.1.3 Setpoint overlap restriction (Mandatory). Where a *zone* has a separate heating and a separate cooling thermostatic control located within the *zone*, a limit switch, mechanical stop or direct digital control system with software programming shall be configured to prevent the heating setpoint from exceeding the cooling setpoint and to maintain a deadband in accordance with Section C403.4.1.2.

C403.4.1.4 Heated or cooled vestibules (Mandatory). The heating system for heated vestibules and air curtains with integral heating shall be provided with controls configured to shut off the source of heating when the outdoor air temperature is greater than 45°F (7°C). Vestibule heating and cooling systems shall be controlled by a thermostat located in the vestibule configured to limit heating to a temperature not greater than 60°F (16°C) and cooling to a temperature not less than 85°F (29°C).

Exception: Control of heating or cooling provided by site-recovered energy or transfer air that would otherwise be exhausted.

C403.4.1.5 Hot water boiler outdoor temperature setback control (Mandatory). Hot water boilers that supply heat to the building through one- or two-pipe heating systems shall have an outdoor setback control that lowers the boiler water temperature based on the outdoor temperature.

C403.4.2 Off-hour controls (Mandatory). Each *zone* shall be provided with thermostatic setback controls that are controlled by either an automatic time clock or programmable control system.

Exceptions:

1. *Zones* that will be operated continuously.
2. *Zones* with a full HVAC load demand not exceeding 6,800 Btu/h (2 kW) and having a manual shutoff switch located with *ready access*.

C403.4.2.1 Thermostatic setback (Mandatory). Thermostatic setback controls shall be configured to set back or temporarily operate the system to maintain zone temperatures down to 55°F (13°C) or up to 85°F (29°C).

C403.4.2.2 Automatic setback and shutdown (Mandatory). Automatic time clock or programmable controls shall be capable of starting and stopping the system for seven different daily schedules per week and retaining their programming and time setting during a loss of power for not fewer than 10 hours. Additionally, the controls shall have a manual override that allows temporary operation of the system for up to 2 hours; a manually operated timer configured to operate the system for up to 2 hours; or an occupancy sensor.

C403.4.2.3 Automatic start (Mandatory). Automatic start controls shall be provided for each HVAC system. The controls shall be configured to automatically adjust the daily start time of the HVAC system in order to bring each space to the desired occupied temperature immediately prior to scheduled occupancy.

C403.4.3 Hydronic systems controls. The heating of fluids that have been previously mechanically cooled and the cooling of fluids that have been previously mechanically heated shall be limited in accordance with Sections C403.4.3.1 through C403.4.3.3. Hydronic heating systems comprised of multiple-packaged boilers and designed to deliver conditioned water or steam into a common distribution system shall include automatic controls configured to sequence operation of the boilers. Hydronic heating systems composed of a single boiler and greater than 500,000 Btu/h (146.5 kW) input design capacity shall include either a multistaged or modulating burner.

C403.5 Economizers (~~Prescriptive~~). Economizers shall comply with Sections C403.5.1 through C403.5.5. An air or water economizer shall be provided for the following cooling systems:

1. Chilled water systems with a total cooling capacity, less cooling capacity provided with air economizers, as specified in Table C403.5(1).
2. Individual fan systems with cooling capacity greater than or equal to 54,000 Btu/h (15.8 kW) in buildings having other than a *Group R* occupancy. The total supply capacity of all fan cooling units not provided with economizers shall not exceed 20 percent of the total supply capacity of all fan cooling units in the building or 300,000 Btu/h (88 kW), whichever is greater.
3. Individual fan systems with cooling capacity greater than or equal to 270,000 Btu/h (79.1 kW) in buildings having a *Group R* occupancy. The total supply capacity of all fan cooling units not provided with economizers shall not exceed 20 percent of the total supply capacity of all fan cooling units in the building or 1,500,000 Btu/h (440 kW), whichever is greater.

Exceptions: Economizers are not required for the following systems.

1. Individual fan systems not served by chilled water for buildings located in *Climate Zones* 1A and 1B.
2. Where more than 25 percent of the air designed to be supplied by the system is to spaces that are designed to be humidified above 35°F (1.7°C) dew-point temperature to satisfy process needs.
3. Systems expected to operate less than 20 hours per week.
4. Systems serving supermarket areas with open refrigerated casework.
5. Where the cooling efficiency is greater than or equal to the efficiency requirements in Table C403.5(2).
6. Systems that include a heat recovery system in accordance with Section C403.9.5.

C403.5.5 Economizer fault detection and diagnostics (~~Mandatory~~). Air-cooled unitary direct-expansion units listed in Tables C403.3.2(1) through C403.3.2(3) and variable refrigerant flow (VRF) units that are equipped with an economizer in accordance with Sections C403.5 through C403.5.4 shall include a fault detection and diagnostics system complying with the following:

1. The following temperature sensors shall be permanently installed to monitor system operation:
 - 1.1. Outside air.
 - 1.2. Supply air.
 - 1.3. Return air.
2. Temperature sensors shall have an accuracy of $\pm 2^{\circ}\text{F}$ (1.1°C) over the range of 40°F to 80°F (4°C to 26.7°C).
3. Refrigerant pressure sensors, where used, shall have an accuracy of ± 3 percent of full scale.
4. The unit controller shall be configured to provide system status by indicating the following:
 - 4.1. Free cooling available.
 - 4.2. Economizer enabled.
 - 4.3. Compressor enabled.

- 4.4. Heating enabled.
- 4.5. Mixed air low limit cycle active.
- 4.6. The current value of each sensor.
- 5. The unit controller shall be capable of manually initiating each operating mode so that the operation of compressors, economizers, fans and the heating system can be independently tested and verified.
- 6. The unit shall be configured to report faults to a fault management application available for access by day-to-day operating or service personnel, or annunciated locally on zone thermostats.
- 7. The fault detection and diagnostics system shall be configured to detect the following faults:
 - 7.1. Air temperature sensor failure/fault.
 - 7.2. Not economizing when the unit should be economizing.
 - 7.3. Economizing when the unit should not be economizing.
 - 7.4. Damper not modulating.
 - 7.5. Excess outdoor air.

C403.7.1 Demand control ventilation (Mandatory). Demand control ventilation (DCV) shall be provided for spaces larger than 500 square feet (46.5 m²) and with an average occupant load of 25 people or greater per 1,000 square feet (93 m²) of floor area, as established in Table 403.3.1.1 of the International Mechanical Code, and served by systems with one or more of the following:

- 1. An air-side economizer.
- 2. Automatic modulating control of the outdoor air damper.
- 3. A design outdoor airflow greater than 3,000 cfm (1416 L/s).

Exceptions:

- 1. Systems with energy recovery complying with Section C403.7.4.
- 2. Multiple-zone systems without direct digital control of individual zones communicating with a central control panel.
- 3. Systems with a design outdoor airflow less than 1,200 cfm (566 L/s).
- 4. Spaces where the supply airflow rate minus any makeup or outgoing transfer air requirement is less than 1,200 cfm (566 L/s).
- 5. Ventilation provided only for process loads.

C403.7.2 Enclosed parking garage ventilation controls (Mandatory). Enclosed parking garages used for storing or handling automobiles operating under their own power shall employ contamination-sensing devices and automatic controls configured to stage fans or modulate fan average airflow rates to 50 percent or less of design capacity, or intermittently operate fans less than 20 percent of the occupied time or as required to maintain acceptable contaminant levels in accordance with International Mechanical Code provisions. Failure of contamination-sensing devices shall cause the exhaust fans to operate continuously at design airflow.

Exceptions:

- 1. Garages with a total exhaust capacity less than 22,500 cfm (10 620 L/s) with ventilation systems that do not utilize heating or mechanical cooling.
- 2. Garages that have a garage area to ventilation system motor nameplate power ratio that exceeds 1125 cfm/hp (710 L/s/kW) and do not utilize heating or mechanical cooling.

C403.7.3 Ventilation air heating control (Mandatory). Units that provide ventilation air to multiple zones and operate in conjunction with zone heating and cooling systems shall not use heating or heat recovery to warm

supply air to a temperature greater than 60°F (16°C) when representative building loads or outdoor air temperatures indicate that the majority of zones require cooling.

C403.7.4 Energy recovery ventilation systems (Mandatory). Where the supply airflow rate of a fan system exceeds the values specified in Tables C403.7.4(1) and C403.7.4(2), the system shall include an energy recovery system. The energy recovery system shall be configured to provide a change in the enthalpy of the outdoor air supply of not less than 50 percent of the difference between the outdoor air and return air enthalpies, at design conditions. Where an air economizer is required, the energy recovery system shall include a bypass or controls that permit operation of the economizer as required by Section C403.5.

Exception: An energy recovery ventilation system shall not be required in any of the following conditions:

1. Where energy recovery systems are prohibited by the International Mechanical Code .
2. Laboratory fume hood systems that include not fewer than one of the following features:
 - 2.1. Variable-air-volume hood exhaust and room supply systems configured to reduce exhaust and makeup air volume to 50 percent or less of design values.
 - 2.2. Direct makeup (auxiliary) air supply equal to or greater than 75 percent of the exhaust rate, heated not warmer than 2°F (1.1 °C) above room setpoint, cooled to not cooler than 3°F (1.7°C) below room setpoint, with no humidification added, and no simultaneous heating and cooling used for dehumidification control.
3. Systems serving spaces that are heated to less than 60°F (15.5°C) and that are not cooled.
4. Where more than 60 percent of the outdoor heating energy is provided from site-recovered or site-solar energy.
5. Heating energy recovery in *Climate Zones* 1 and 2.
6. Cooling energy recovery in *Climate Zones* 3C, 4C, 5B, 5C, 6B, 7 and 8.
7. Systems requiring dehumidification that employ energy recovery in series with the cooling coil.
8. Where the largest source of air exhausted at a single location at the building exterior is less than 75 percent of the design *outdoor air* flow rate.
9. Systems expected to operate less than 20 hours per week at the *outdoor air* percentage covered by Table C403.7.4(1).
10. Systems exhausting toxic, flammable, paint or corrosive fumes or dust.
11. Commercial kitchen hoods used for collecting and removing grease vapors and smoke.

C403.7.5 Kitchen exhaust systems (Mandatory). Replacement air introduced directly into the exhaust hood cavity shall not be greater than 10 percent of the hood exhaust airflow rate. Conditioned supply air delivered to any space shall not exceed the greater of the following:

1. The ventilation rate required to meet the space heating or cooling load.
2. The hood exhaust flow minus the available transfer air from adjacent space where available transfer air is considered to be that portion of outdoor ventilation air not required to satisfy other exhaust needs, such as restrooms, and not required to maintain pressurization of adjacent spaces.

Where total kitchen hood exhaust airflow rate is greater than 5,000 cfm (2360 L/s), each hood shall be a factory-built commercial exhaust hood listed by a nationally recognized testing laboratory in compliance with UL 710. Each hood shall have a maximum exhaust rate as specified in Table C403.7.5 and shall comply with one of the following:

1. Not less than 50 percent of all replacement air shall be transfer air that would otherwise be exhausted.

2. Demand ventilation systems on not less than 75 percent of the exhaust air that are configured to provide not less than a 50-percent reduction in exhaust and replacement air system airflow rates, including controls necessary to modulate airflow in response to appliance operation and to maintain full capture and containment of smoke, effluent and combustion products during cooking and idle.
3. Listed energy recovery devices with a sensible heat recovery effectiveness of not less than 40 percent on not less than 50 percent of the total exhaust airflow.

Where a single hood, or hood section, is installed over appliances with different duty ratings, the maximum allowable flow rate for the hood or hood section shall be based on the requirements for the highest appliance duty rating under the hood or hood section.

Exception: Where not less than 75 percent of all the replacement air is transfer air that would otherwise be exhausted.

C403.7.6 Automatic control of HVAC systems serving guestrooms (Mandatory). In *Group R-1* buildings containing more than 50 guestrooms, each guestroom shall be provided with controls complying with the provisions of Sections C403.7.6.1 and C403.7.6.2. Card key controls comply with these requirements.

C403.7.7 Shutoff dampers (Mandatory). Outdoor air intake and exhaust openings and stairway and shaft vents shall be provided with Class I motorized dampers. The dampers shall have an air leakage rate not greater than 4 cfm/ft² (20.3 L/s • m²) of damper surface area at 1.0 inch water gauge (249 Pa) and shall be labeled by an approved agency when tested in accordance with AMCA 500D for such purpose. Outdoor air intake and exhaust dampers shall be installed with automatic controls configured to close when the systems or spaces served are not in use or during unoccupied period warm-up and setback operation, unless the systems served require outdoor or exhaust air in accordance with the International Mechanical Code or the dampers are opened to provide intentional economizer cooling.

Stairway and shaft vent dampers shall be installed with automatic controls configured to open upon the activation of any fire alarm initiating device of the building's fire alarm system or the interruption of power to the damper.

Exception: Nonmotorized gravity dampers shall be an alternative to motorized dampers for exhaust and relief openings as follows:

1. In buildings less than three stories in height above grade plane.
2. In buildings of any height located in *Climate Zones* 1, 2 or 3.
3. Where the design exhaust capacity is not greater than 300 cfm (142 L/s).

Nonmotorized gravity dampers shall have an air leakage rate not greater than 20 cfm/ft² (101.6 L/s • m²) where not less than 24 inches (610 mm) in either dimension and 40 cfm/ft² (203.2 L/s • m²) where less than 24 inches (610 mm) in either dimension. The rate of air leakage shall be determined at 1.0 inch water gauge (249 Pa) when tested in accordance with AMCA 500D for such purpose. The dampers shall be labeled by an approved agency.

C403.8.1 Allowable fan horsepower (Mandatory). Each HVAC system having a total fan system motor nameplate horsepower exceeding 5 hp (3.7 kW) at fan system design conditions shall not exceed the allowable *fan system motor nameplate hp* (Option 1) or *fan system bhp* (Option 2) shown in Table C403.8.1(1). This includes supply fans, exhaust fans, return/relief fans, and fan-powered terminal units associated with systems providing heating or cooling capability. Single-zone variable air volume systems shall comply with the constant volume fan power limitation.

Exceptions:

1. Hospital, vivarium and laboratory systems that utilize flow control devices on exhaust or return to maintain space pressure relationships necessary for occupant health and safety or environmental control shall be permitted to use variable volume fan power limitation.
2. Individual exhaust fans with motor nameplate horsepower of 1 hp (0.746 kW) or less are exempt from the allowable fan horsepower requirement.

C403.8.2 Motor nameplate horsepower (Mandatory). For each fan, the fan brake horsepower shall be indicated on the construction documents and the selected motor shall be not larger than the first available motor size greater than the following:

1. For fans less than 6 bhp (4413 W), 1.5 times the fan brake horsepower.
2. For fans 6 bhp (4413 W) and larger, 1.3 times the fan brake horsepower.
3. Systems complying with Section C403.8.1 *fan system motor nameplate hp* (Option 1).

Exception: Fans with motor nameplate horsepower less than 1 hp (746 W) are exempt from this section.

C403.8.3 Fan efficiency (Mandatory). Fans shall have a fan efficiency grade (FEG) of not less than 67, as determined in accordance with AMCA 205 by an *approved*, independent testing laboratory and labeled by the manufacturer. The total efficiency of the fan at the design point of operation shall be within 15 percentage points of the maximum total efficiency of the fan.

Exception: The following fans are not required to have a fan efficiency grade:

1. Fans of 5 hp (3.7 kW) or less as follows:
 - 1.1. Individual fans with a motor nameplate horsepower of 5 hp (3.7 kW) or less, unless Exception 1.2 applies.
 - 1.2. Multiple fans in series or parallel that have a combined motor nameplate horsepower of 5 hp (3.7 kW) or less and are operated as the functional equivalent of a single fan.
2. Fans that are part of equipment covered in Section C403.3.2.
3. Fans included in an equipment package certified by an *approved agency* for air or energy performance.
4. Powered wall/roof ventilators.
5. Fans outside the scope of AMCA 205.
6. Fans that are intended to operate only during emergency conditions.

C403.8.4 Fractional hp fan motors (Mandatory). Motors for fans that are not less than $\frac{1}{12}$ hp (0.082 kW) and less than 1 hp (0.746 kW) shall be electronically commutated motors or shall have a minimum motor efficiency of 70 percent, rated in accordance with DOE 10 CFR 431. These motors shall have the means to adjust motor speed for either balancing or remote control. The use of belt-driven fans to sheave adjustments for airflow balancing instead of a varying motor speed shall be permitted.

Exceptions: The following motors are not required to comply with this section

1. Motors in the airstream within fan coils and terminal units that only provide heating to the space served.
2. Motors in space-conditioning equipment that comply with Section C403.3.2 or Sections C403.8.1. through C403.8.3.
3. Motors that comply with Section C405.7.

C403.10.1 Walk-in coolers, walk-in freezers, refrigerated warehouse coolers and refrigerated warehouse freezers (Mandatory). *Refrigerated warehouse coolers and refrigerated warehouse freezers* shall comply with this section. *Walk-in coolers and walk-in freezers* that are neither site assembled nor site constructed shall comply with the following:

1. Be equipped with automatic door-closers that firmly close walk-in doors that have been closed to within 1 inch (25 mm) of full closure.
Exception: Automatic closers are not required for doors more than 45 inches (1143 mm) in width or more than 7 feet (2134 mm) in height.
2. Doorways shall have strip doors, curtains, spring-hinged doors or other method of minimizing infiltration when doors are open.
3. *Walk-in coolers and refrigerated warehouse coolers* shall contain wall, ceiling, and door insulation of not less than R-25 and *walk-in freezers and refrigerated warehouse freezers* shall contain wall, ceiling and door insulation of not less than R-32.
Exception: Glazed portions of doors or structural members need not be insulated.
4. *Walk-in freezers* shall contain floor insulation of not less than R-28.
5. Transparent reach-in doors for *walk-in freezers* and windows in *walk-in freezer* doors shall be of triple-pane glass, either filled with inert gas or with heat-reflective treated glass.
6. Windows and transparent reach-in doors for *walk-in coolers* shall be of double-pane or triple-pane, inert gas-filled, heat-reflective treated glass.
7. Evaporator fan motors that are less than 1 hp (0.746 kW) and less than 460 volts shall use electronically commutated motors, brushless direct-current motors, or 3-phase motors.
8. Condenser fan motors that are less than 1 hp (0.746 kW) shall use electronically commutated motors, permanent split capacitor-type motors or 3-phase motors.
9. Where antisweat heaters without antisweat heater controls are provided, they shall have a total door rail, glass and frame heater power draw of not more than 7.1 W/ft² (76 W/m²) of door opening for *walk-in freezers* and 3.0 W/ft² (32 W/m²) of door opening for *walk-in coolers*.
10. Where antisweat heater controls are provided, they shall reduce the energy use of the antisweat heater as a function of the relative humidity in the air outside the door or to the condensation on the inner glass pane.
11. Lights in *walk-in coolers, walk-in freezers, refrigerated warehouse coolers and refrigerated warehouse freezers* shall either use light sources with an efficacy of not less than 40 lumens per watt, including ballast losses, or shall use light sources with an efficacy of not less than 40 lumens per watt, including ballast losses, in conjunction with a device that turns off the lights within 15 minutes when the space is not occupied.

C403.10.2 Walk-in coolers and walk-in freezers (Mandatory). Site-assembled or site-constructed *walk-in coolers and walk-in freezers* shall comply with the following:

1. Automatic door closers shall be provided that fully close walk-in doors that have been closed to within 1 inch (25 mm) of full closure.
Exception: Closers are not required for doors more than 45 inches (1143 mm) in width or more than 7 feet (2134 mm) in height.
2. Doorways shall be provided with strip doors, curtains, spring-hinged doors or other method of minimizing infiltration when the doors are open.
3. Walls shall be provided with insulation having a thermal resistance of not less than R-25, ceilings shall be provided with insulation having a thermal resistance of not less than R-25 and doors of *walk-in coolers and walk-in freezers* shall be provided with insulation having a thermal resistance of not less than R-32.

Exception: Insulation is not required for glazed portions of doors or at structural members

associated with the walls, ceiling or door frame.

4. The floor of *walk-in freezers* shall be provided with insulation having a thermal resistance of not less than R-28.
5. Transparent reach-in doors for and windows in opaque *walk-in freezer* doors shall be provided with triple-pane glass having the interstitial spaces filled with inert gas or provided with heat-reflective treated glass.
6. Transparent reach-in doors for and windows in opaque *walk-in cooler* doors shall be double-pane heat-reflective treated glass having the interstitial space gas filled.
7. Evaporator fan motors that are less than 1 hp (0.746 kW) and less than 460 volts shall be electronically commutated motors or 3-phase motors.
8. Condenser fan motors that are less than 1 hp (0.746 kW) in capacity shall be of the electronically commutated or permanent split capacitor-type or shall be 3-phase motors.

Exception: Fan motors in *walk-in coolers* and *walk-in freezers* combined in a single enclosure greater than 3,000 square feet (279 m²) in floor area are exempt.

9. Antisweat heaters that are not provided with anti-sweat heater controls shall have a total door rail, glass and frame heater power draw not greater than 7.1 W/ft² (76 W/m²) of door opening for *walk-in freezers*, and not greater than 3.0 W/ft² (32 W/m²) of door opening for *walk-in coolers*.
10. Antisweat heater controls shall be configured to reduce the energy use of the antisweat heater as a function of the relative humidity in the air outside the door or to the condensation on the inner glass pane.
11. Light sources shall have an efficacy of not less than 40 lumens per Watt, including any ballast losses, or shall be provided with a device that automatically turns off the lights within 15 minutes of when the *walk-in cooler* or *walk-in freezer* was last occupied.

C403.10.2.1 Performance standards (Mandatory). Effective January 1, 2020, *walk-in coolers* and *walk-in freezers* shall meet the requirements of Tables C403.10.2.1(1), C403.10.2.1(2) and C403.10.2.1(3).

C403.10.3 Refrigerated display cases (Mandatory). Site-assembled or site-constructed refrigerated display cases shall comply with the following:

1. Lighting and glass doors in refrigerated display cases shall be controlled by one of the following:
 - 1.1. Time-switch controls to turn off lights during nonbusiness hours. Timed overrides for display cases shall turn the lights on for up to 1 hour and shall automatically time out to turn the lights off.
 - 1.2. Motion sensor controls on each display case section that reduce lighting power by not less than 50 percent within 3 minutes after the area within the sensor range is vacated.
2. Low-temperature display cases shall incorporate temperature-based defrost termination control with a time-limit default. The defrost cycle shall terminate first on an upper temperature limit breach and second upon a time limit breach.
3. Antisweat heater controls shall reduce the energy use of the antisweat heater as a function of the relative humidity in the air outside the door or to the condensation on the inner glass pane.

C403.11.1 Duct and plenum insulation and sealing (Mandatory). Supply and return air ducts and plenums shall be insulated with not less than R-6 insulation where located in unconditioned spaces and where located outside the building with not less than R-8 insulation in *Climate Zones* 1 through 4 and not less than R-12 insulation in *Climate Zones* 5 through 8. Where located within a building envelope assembly, the duct or plenum shall be separated from the building exterior or unconditioned or exempt spaces by not less than R-8 insulation in *Climate Zones* 1 through 4 and not less than R-12 insulation in *Climate Zones* 5 through 8.

Exceptions:

1. Where located within equipment.
2. Where the design temperature difference between the interior and exterior of the duct or plenum is not greater than 15°F (8°C).

Ducts, air handlers and filter boxes shall be sealed. Joints and seams shall comply with Section 603.9 of the International Mechanical Code.

C403.11.2 Duct construction (Mandatory). Ductwork shall be constructed and erected in accordance with the International Mechanical Code .

C403.11.2.1 Low-pressure duct systems (Mandatory). Longitudinal and transverse joints, seams and connections of supply and return ducts operating at a static pressure less than or equal to 2 inches water gauge (w.g.) (498 Pa) shall be securely fastened and sealed with welds, gaskets, mastics (adhesives), mas-tic-plus-embedded-fabric systems or tapes installed in accordance with the manufacturer's instructions. Pressure classifications specific to the duct system shall be clearly indicated on the construction documents in accordance with the International Mechanical Code .

Exception: Locking-type longitudinal joints and seams, other than the snap-lock and button-lock types, need not be sealed as specified in this section.

C403.11.2.2 Medium-pressure duct systems (Mandatory). Ducts and plenums designed to operate at a static pressure greater than 2 inches water gauge (w.g.) (498 Pa) but less than 3 inches w.g. (747 Pa) shall be insulated and sealed in accordance with Section C403.11.1. Pressure classifications specific to the duct system shall be clearly indicated on the construction documents in accordance with the International Mechanical Code .

C403.11.2.3 High-pressure duct systems (Mandatory). Ducts and plenums designed to operate at static pressures equal to or greater than 3 inches water gauge (747 Pa) shall be insulated and sealed in accordance with Section C403.11.1. In addition, ducts and plenums shall be leak tested in accordance with the SMACNA HVAC Air Duct Leakage Test Manual and shown to have a rate of air leakage (CL) less than or equal to 4.0 as determined in accordance with Equation 4-8.

$$CL = F/P^{0.65}$$

$$CL = F/P^{0.65}$$

(Equation 4-8)

where:

F = The measured leakage rate in cfm per 100 square feet of duct surface.

P = The static pressure of the test.

Documentation shall be furnished by the designer demonstrating that representative sections totaling not less than 25 percent of the duct area have been tested and that all tested sections comply with the requirements of this section.

C403.11.3 Piping insulation (Mandatory). Piping serving as part of a heating or cooling system shall be thermally insulated in accordance with Table C403.11.3.

Exceptions:

1. Factory-installed piping within HVAC equipment tested and rated in accordance with a test procedure referenced by this code.
2. Factory-installed piping within room fan-coils and unit ventilators tested and rated according to AHRI 440 (except that the sampling and variation provisions of Section 6.5 shall not apply) and AHRI 840, respectively.

3. Piping that conveys fluids that have a design operating temperature range between 60°F (15°C) and 105°F (41°C).
4. Piping that conveys fluids that have not been heated or cooled through the use of fossil fuels or electric power.
5. Strainers, control valves, and balancing valves associated with piping 1 inch (25 mm) or less in diameter.
6. Direct buried piping that conveys fluids at or below 60°F (15°C).

C403.11.3.1 Protection of piping insulation (Mandatory). Piping insulation exposed to the weather shall be protected from damage, including that caused by sunlight, moisture, equipment maintenance and wind, and shall provide shielding from solar radiation that can cause degradation of the material. Adhesive tape shall not be permitted.

C403.12 Mechanical systems located outside of the building thermal envelope (Mandatory). Mechanical systems providing heat outside of the thermal envelope of a building shall comply with Sections C403.12.1 through C403.12.3.

SECTION C404 SERVICE WATER HEATING ~~(MANDATORY)~~

C404.9 Energy consumption of pools and permanent spas (Mandatory). The energy consumption of pools and permanent spas shall be controlled by the requirements in Sections C404.9.1 through C404.9.3.

C404.10 Energy consumption of portable spas (Mandatory). The energy consumption of electric-powered portable spas shall be controlled by the requirements of APSP 14.

C405.1 General (Mandatory). This section covers lighting system controls, the maximum lighting power for interior and exterior applications and electrical energy consumption.

Dwelling units within multifamily buildings shall comply with Section R404.1. All other *dwelling units* shall comply with Section R404.1, or with Sections C405.2.4 and C405.3. *Sleeping units* shall comply with Section C405.2.4, and with Section R404.1 or C405.3. Lighting installed in walk-in coolers, walk-in freezers, refrigerated warehouse coolers and refrigerated warehouse freezers shall comply with the lighting requirements of Section C403.10.1 or C403.10.2.

C405.2 Lighting controls (Mandatory). Lighting systems shall be provided with controls that comply with one of the following.

1. Lighting controls as specified in Sections C405.2.1 through C405.2.6.
2. Luminaire level lighting controls (LLLC) and lighting controls as specified in Sections C405.2.1, C405.2.4 and C405.2.5. The LLLC luminaire shall be independently capable of:
 - 2.1. Monitoring occupant activity to brighten or dim lighting when occupied or unoccupied, respectively.
 - 2.2. Monitoring ambient light, both electric light and daylight, and brighten or dim artificial light to maintain desired light level.
 - 2.3. For each control strategy, configuration and reconfiguration of performance parameters including; bright and dim setpoints, timeouts, dimming fade rates, sensor sensitivity adjustments, and wireless zoning configurations.

Exceptions: Lighting controls are not required for the following:

1. Areas designated as security or emergency areas that are required to be continuously lighted.

2. Interior exit stairways, interior exit ramps and exit passageways.
3. Emergency egress lighting that is normally off.

C405.3 Interior lighting power requirements (Prescriptive). A building complies with this section where its total connected interior lighting power calculated under Section C405.3.1 is not greater than the interior lighting power allowance calculated under Section C405.3.2.

C405.4 Exterior lighting power requirements (Mandatory). The total connected exterior lighting power calculated in accordance with Section C405.4.1 shall be not greater than the exterior lighting power allowance calculated in accordance with Section C405.4.2.

C405.4.3 Gas lighting (Mandatory). Gas-fired lighting appliances shall not be equipped with continuously burning pilot ignition systems.

C405.5 Dwelling electrical meter (Mandatory). Each dwelling unit located in a *Group R-2* building shall have a separate electrical meter.

C405.6 Electrical transformers (Mandatory). Low-voltage dry-type distribution electric transformers shall meet the minimum efficiency requirements of Table C405.6 as tested and rated in accordance with the test procedure listed in DOE 10 CFR 431. The efficiency shall be verified through certification under an approved certification program or, where a certification program does not exist, the equipment efficiency ratings shall be supported by data furnished by the transformer manufacturer.

Exceptions: The following transformers are exempt:

1. Transformers that meet the *Energy Policy Act of 2005* exclusions based on the DOE 10 CFR 431 definition of special purpose applications.
2. Transformers that meet the *Energy Policy Act of 2005* exclusions that are not to be used in general purpose applications based on information provided in DOE 10 CFR 431.
3. Transformers that meet the *Energy Policy Act of 2005* exclusions with multiple voltage taps where the highest tap is not less than 20 percent more than the lowest tap.
4. Drive transformers.
5. Rectifier transformers.
6. Auto-transformers.
7. Uninterruptible power system transformers.
8. Impedance transformers.
9. Regulating transformers.
10. Sealed and nonventilating transformers.
11. Machine tool transformers.
12. Welding transformers.
13. Grounding transformers.
14. Testing transformers.

C405.7 Electric (Mandatory). Electric motors shall meet the minimum efficiency requirements of Tables C405.7(1) through C405.7(4) when tested and rated in accordance with the DOE 10 CFR 431. The efficiency shall be verified through certification under an approved certification program or, where a certification program does not exist, the equipment efficiency ratings shall be supported by data furnished by the motor manufacturer.

Exception: The standards in this section shall not apply to the following exempt electric motors:

1. Air-over electric motors.

2. Component sets of an electric motor.
3. Liquid-cooled electric motors.
4. Submersible electric motors.
5. Inverter-only electric motors.

Proposal # 4192

CE42-19 Part I

CE42-19 Part II

IECC: R102.1.1 (IRC N1101.4), R401.3 (IRC N1101.14), R402.1 (IRC N1102.1), R402.2 (IRC N1102.2), R402.3 (IRC N1102.3), R402.4 (IRC N1102.4), R402.5 (IRC N1102.5), R403.1 (IRC N1103.1), R403.1.2 (IRC N1103.1.2), R403.3.1 (IRC N1103.3.1), R403.3.2 (IRC N1103.3.2), R403.3.3 (IRC N1103.3.3), R403.3.4 (IRC N1103.3.4), R403.3.5 (IRC N1103.3.5), R403.4 (IRC N1103.4), R403.5.1 (IRC N1103.5.1), R403.5.3 (IRC N1103.5.3), R403.6 (IRC N1103.6), R403.7 (IRC N1103.7), R403.8 (IRC N1103.8), R403.9 (IRC N1103.9), R403.10 (IRC N1103.10), R403.11 (IRC N1103.11), R404.1 (IRC N1104.1), R404.1.1 (IRC N1104.1.1) R405 (N1105), R405.2 (IRC N1105.2), TABLE R405.2 (IRC N1105.2) (New), R405.3 (IRC N1105.3), R406 (IRC N1106), R406.2 (IRC N1106.2), TABLE R406.2 (IRC N1106.2) (New), R406.3 (IRC N1106.3), R406.3.1 (IRC N1105.3.1), R406.3.2 (IRC N1106.3.2), TABLE R406.4 (IRC N1106.4)

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:

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~~ Table R405.2 shall be met.

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.

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.

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 designed in accordance with ICC 400.

R402.2 (IRC N1102.2) Specific insulation requirements (~~Prescriptive~~). In addition to the requirements of Section R402.1, insulation shall meet the specific requirements of Sections R402.2.1 through R402.2.13.

R402.3 (IRC N1102.3) Fenestration (~~Prescriptive~~). In addition to the requirements of Section R402, fenestration shall comply with Sections R402.3.1 through R402.3.5.

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.

R402.5 (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.

R403.1 (IRC N1103.1) Controls (~~Mandatory~~). Not less than one thermostat shall be provided for each separate heating and cooling system.

R403.1.2 (IRC N1103.1.2) Heat pump supplementary heat (~~Mandatory~~). Heat pumps having supplementary electric-resistance heat shall have controls that, except during defrost, prevent supplemental heat operation when the heat pump compressor can meet the heating load.

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.

R403.3.3 (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 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 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.

R403.3.5 (IRC N1103.3.5) Building cavities (~~Mandatory~~). *Building* framing cavities shall not be used as ducts or plenums.

R403.4 (IRC N1103.4) Mechanical system piping insulation (~~Mandatory~~). Mechanical system piping capable of carrying fluids greater than 105°F (41°C) or less than 55°F (13°C) shall be insulated to an R-value of not less than R-3.

R403.5.1 (IRC N1103.5.1) Heated water circulation and temperature maintenance systems (~~Mandatory~~). Heated water circulation systems shall be in accordance with Section R403.5.1.1. Heat trace temperature maintenance systems shall be in accordance with Section R403.5.1.2. Automatic controls, temperature sensors and pumps shall be *accessible*. Manual controls shall be readily *accessible*.

R403.5.3 (IRC N1103.5.3) Hot water pipe insulation (~~Prescriptive~~). 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 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.
6. Buried piping.
7. Supply and return piping in recirculation systems other than demand recirculation systems.

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.

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.

R403.8 (IRC N1103.8) Systems serving multiple dwelling units (~~Mandatory~~). Systems serving multiple

dwelling units shall comply with Sections C403 and C404 of the International Energy Conservation Code—Commercial Provisions instead of Section R403.

R403.9 (IRC N1103.9) Snow melt and ice system controls (~~Mandatory~~). Snow- and ice-melting systems, supplied through energy service to the building, shall include automatic controls capable of shutting off the system when the pavement temperature is greater than 50°F (10°C) and precipitation is not falling, and an automatic or manual control that will allow shutoff when the outdoor temperature is greater than 40°F (4.8°C).

R403.10 (IRC N1103.10) Pools and permanent spa energy consumption (~~Mandatory~~). The energy consumption of pools and permanent spas shall be in accordance with Sections R403.10.1 through R403.10.3.

R403.11 (IRC N1103.11) Portable spas (~~Mandatory~~). The energy consumption of electric-powered portable spas shall be controlled by the requirements of APSP-14.

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.

R404.1.1 (IRC N1104.1.1) Lighting equipment (~~Mandatory~~). Fuel gas lighting systems shall not have continuously burning pilot lights.

SECTION R405 (N1105)

SIMULATED PERFORMANCE ALTERNATIVE (PERFORMANCE) TOTAL BUILDING PERFORMANCE

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.

R405.2 (IRC N1105.2) ~~Mandatory requirements.~~ Performance Based Compliance. Compliance with this section based on total building performance requires that ~~the mandatory provisions identified in Section R401.2 be met.~~ a proposed design meets all of the following:

1. The requirements of the sections indicated within Table R405.2
2. Supply and return ducts not completely inside the *building thermal envelope* shall be insulated to an *R*-value of not less than R-6.
3. 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

Add new text as follows:

TABLE R405.2 (IRC N1105.2)
REQUIREMENTS FOR TOTAL BUILDING PERFORMANCE

<u>Section^a</u>	<u>Title</u>
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<u>General</u>	
<u>R401.3</u>	<u>Certificate</u>
<u>Envelope</u>	
<u>R402.1.1</u>	<u>Vapor Retarder</u>
<u>R402.4</u>	<u>Air Leakage</u>
<u>R402.5</u>	<u>Maximum fenestration U-factor and SHGC</u>
<u>Mechanical</u>	
<u>R403.1</u>	<u>Controls</u>
<u>R403.3, except sections R403.3.1, R403.3.4, R403.3.6 and R403.3.7</u>	<u>Ducts</u>
<u>R403.4</u>	<u>Mechanical system piping insulation</u>
<u>R403.5.1</u>	<u>Heated water circulation and temperature maintenance systems</u>
<u>R403.6</u>	<u>Mechanical ventilation</u>
<u>R403.7</u>	<u>Equipment sizing and efficiency rating</u>
<u>R403.8</u>	<u>Systems serving multiple dwelling units</u>
<u>R403.9</u>	<u>Snow melt and ice systems</u>
<u>R403.10</u>	<u>Pools and permanent spa energy consumption</u>
<u>R403.11</u>	<u>Portable spas</u>
<u>Electrical Power and Lighting Systems</u>	
<u>R404.1</u>	<u>Lighting equipment</u>

^a Reference to a code section includes all the relative subsections except as indicated in the table.

Delete without substitution:

~~**R405.3 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.~~

Revise as follows:

SECTION R406 (IRC N1106)

ENERGY RATING INDEX COMPLIANCE ALTERNATIVE

R406.1 (IRC N1106.1) Scope. This section establishes criteria for compliance using an Energy Rating Index (ERI) analysis.

Delete and substitute as follows:

R406.2 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.

R406.2 ERI Compliance Compliance based on the Energy Rating Index requires that the rated design meets all of the following:

1. The requirements of the sections indicated within Table R406.2
2. Supply and return ducts not completely inside the *building thermal envelope* shall be insulated to an *R*-value of not less than R-6.
3. Maximum energy rating index of Table R406.4

Add new text as follows:

TABLE R406.2 (IRC N1106.2)
REQUIREMENTS FOR ENERGY RATING INDEX

Section^a	Title
General	-
<u>R401.3</u>	<u>Certificate</u>
<u>Building Thermal Envelope</u>	
<u>R402.1.1</u>	<u>Vapor Retarder</u>
<u>R402.4</u>	<u>Air Leakage</u>
<u>R406.3</u>	<u>Building Thermal Envelope</u>
<u>Systems</u>	
<u>R403.1</u>	<u>Controls</u>
<u>R403.3 except sections R403.3.1, R403.3.4, R403.3.6, and R403.3.7</u>	<u>Ducts</u>
<u>R403.4</u>	<u>Mechanical system piping insulation</u>
<u>R403.5.1</u>	<u>Heated water circulation and temperature maintenance systems</u>
<u>R403.6</u>	<u>Mechanical ventilation</u>
<u>R403.7</u>	<u>Equipment sizing and efficiency rating</u>
<u>R403.8</u>	<u>Systems serving multiple dwelling units</u>
<u>R403.9</u>	<u>Snow melt and ice systems</u>
<u>R403.10</u>	<u>Pools and permanent spa energy consumption</u>
<u>R403.11</u>	<u>Portable spas</u>
<u>R403.12</u>	<u>Residential pools and permanent residential spas</u>
<u>Electrical Power and Lighting Systems</u>	
<u>R404.1</u>	<u>Lighting equipment</u>

^a Reference to a code section includes all of the relative subsections except as indicated in the table.

R406.3 (IRC N1106.3) Building Thermal Envelope Building and portions thereof shall comply with Section R406.3.1 or R406.3.2.

R406.3.1 (IRC N1105.3.1) On-site renewables are not included. Where on-site renewable is not included for compliance using the ERI analysis of Section R406.4, 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.

R406.3.2 (IRC N1106.3.2) On-site renewables are included 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 2015 International Energy Conservation Code.

Revise as follows:

**TABLE R406.4 (IRC N1106.4)
MAXIMUM ENERGY RATING INDEX**

CLIMATE ZONE	ENERGY RATING INDEX^a
1	57
2	57
3	57
4	62
5	61
6	61
7	58
8	58

~~a. 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 2015 International Energy Conservation Code.~~

Reason: No technical changes are intended. 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, as explained below.

The labels “prescriptive” and “mandatory” are found in the IECC but they are not used consistently and no direction is provided for the intended application of the provisions with such labels. These terms are applied to various section and subsection titles throughout the IECC creating confusion for users of the code. The SEHPCAC reviewed every section of the IECC with the goal of simplifying the code by removing ‘mandatory’ and ‘prescriptive’ labels and finding a better way to communicate distinctions for what is required between the performance and prescriptive paths of the code.

The labels are not requirements and are not enforceable. It is SEHPCAC’s understanding that ‘mandatory’ was intended to mean ‘non-tradeable’ when using performance compliance options, meaning that where the procedures or systems described within the ‘mandatory’ section are included as part of the design, the requirements of that section must be met and it cannot be traded off. “Prescriptive”, on the other hand, was intended to mean “mandatory” when using the prescriptive path, but “tradeable” when using the performance path.

'Mandatory' requirements for the Total Building Performance compliance alternative as they are currently found in the code are identified and made enforceable by the charging language in R401.2 (2) and by reference from R405.2 (Mandatory requirements). "Mandatory" requirements for the Energy Rating Index compliance alternative as they are currently found in the code are identified and made enforceable by the charging language in R406.2 (Mandatory requirements).

This proposal borrows a formatting concept from the City of Seattle using a tabular approach to clearly identify the sections that are non-tradeable ('mandatory') when complying with either of the performance compliance alternatives. Proposed new Table R405.2 lists the section references to all required ('mandatory') measures for this specific compliance path, and proposed new Table R406.2 lists the section references to all required ("mandatory") measures for that specific compliance path. (An identical treatment of the performance path is also being proposed for the IECC-C to maintain consistent application and formatting).

The non-tradeable sections that populate the proposed new Tables R405.2 and R406.2 were identified using the following criteria:

- The section was specifically identified as a mandatory requirement by R401.2 (2) or R406.2.
- The subsection was specifically labeled 'mandatory' in the body of the code (e.g. R403.3.2) even though the parent section was not (R403.3) and other companion subsections were not (e.g. R403.3.1)
- For subsections, the parent section was labeled 'mandatory' and no subsection was labeled otherwise (e.g. R402.4)
- Compliance was required by reference to another code (e.g. R402.1.1)

Where all of a section has been identified as mandatory (e.g. R402.4), just that section number is listed in the table; a tabular footnote explains that all relative subsections are included.

Where subsections are identified as 'prescriptive,' (e.g. R403.3.1), but the parent section or associated subsections are identified as 'mandatory' (e.g. R403.3.2), an exception is provided for the 'prescriptive' subsection in new Tables R405.2 and R406.2 to make clear which subsections apply in each performance compliance alternative.

This reason statement includes a discussion version of new Tables R405.2/R406.2 that features an additional column which identifies what criteria were used to establish the related section's presence in the table. This additional column is not actually proposed for inclusion in the code and is merely for the convenience of the reviewers of the proposal.

Note that the discussion version of new Tables R405.2/R406.2 also features expanded rows (e.g. the R402.4 series) to identify the relevant criteria used to validate their inclusion in the new tables.

Adoption of new Tables R405.2 and R406.2 means that the R401.2 (2) and R406.2 laundry lists of mandatory requirements are no longer needed and that all 'mandatory' and 'prescriptive' labels are no longer needed.

Note that a number of the sections that the SEHPCAC reviewed did not meet the preceding criteria for populating new Tables R405.2 and R406.2 because they were not clearly 'prescriptive' or tradeable. Those sections are not proposed to be added to either new table as part of this proposal. Instead, those sections are proposed to be added to the new tables through separate individual code changes. SEHPCAC has simply called out these provisions to aid the committee's and membership's decision as to whether any of those individual sections is actually 'mandatory' or non-tradeable and appropriate for inclusion in new Tables R405.2 and R406.2.

Finally, a modification to Section R102.1.1 is required with the elimination of the labels identifying “mandatory” provisions.

Section	Title	Reasoning
General		
R401.3	Certificate	Labeled
Envelope		
R402.1.1	Vapor Retarder	References IRC, in which it is required
R402.4	Air Leakage	Labeled
R402.4.1	Building thermal envelope	Under Charging Lang Consist
R402.4.1.1	Installation	Under Charging Lang Consist
R402.4.1.2	Testing	Under Charging Lang Consist
R402.4.2	Fireplaces	Under Charging Lang Consist
R402.4.3	Fenestration air leakage	Under Charging Lang Consist
R402.4.4	Rooms containing fuel burning appliances	Under Charging Lang Consist
R402.4.5	Recessed lighting	Under Charging Lang Consist
R402.5	Maximum fenestration U-factor and SHGC	Included only in Table R405.2 - Labeled
R406.3	Building Thermal Envelope	Included only in Table R406.2 - Specified in Mandatory provisions Section R406.2 and Table R406.4 footnote a
Mechanical		
R403.1	Controls	Labeled
R403.1.1	Programmable thermostat	Under charging lang
R403.1.2	Heat pump supplementary heat	Labeled
R403.3.2	Sealing	Labeled
R403.3.2.1	Sealed air handler	Under charging lang
R403.3.3	Duct testing	Labeled
R403.3.5	Building cavities	Labeled
R403.4	Mechanical system piping insulation	Labeled
R403.4.1	Protection of piping insulation	Under charging lang
R403.5.1	Heated water circulation and temperature maintenance systems	Labeled
R403.5.1.1	Circulation systems	Under charging lang
R403.5.1.2	Heat trace systems	Under charging lang
R403.6	Mechanical ventilation	Labeled
R403.6.1	Whole-house mechanical ventilation system fan efficiency	Under charging lang
R403.7	Equipment sizing and efficiency rating	Labeled
R403.8	Systems serving multiple dwelling units	Labeled

R403.9	Snow melt and ice systems	Labeled
R403.10	Pools and permanent spa energy consumption	Labeled
R403.10.1	Heaters	Under charging lang
R403.10.2	Time switches	Under charging lang
R403.10.3	Covers	Under charging lang
R403.11	Portable spas	Labeled
Lighting		
R404.1	Lighting equipment	Labeled
R404.1.1	Lighting equipment	Labeled

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>
<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 restructuring of information on mandatory provisions, not change to the provisions themselves

Proposal # 4423

CE42-19 Part II

CE43-19

IECC: C401.2, Chapter 6CE (New)

Proponent: Steven Rosenstock, Edison Electric Institute, representing Edison Electric Institute
(srosenstock@eei.org)

2018 International Energy Conservation Code

Revise as follows:

C401.2 Application. Commercial buildings shall comply with one of the following:

1. The requirements of ANSI/ASHRAE/IESNA 90.1.
2. The requirements of ANSI/ASHRAE 90.4 for Data Centers.
3. The requirements of Sections C402 through C405 and C408. In addition, commercial buildings shall comply with Section C406 and tenant spaces shall comply with Section C406.1.1.
4. The requirements of Sections C402.5, C403.2, C403.3 through C403.3.2, C403.4 through C403.4.2.3, C403.5.5, C403.7, C403.8.1 through C403.8.4, C403.10.1 through C403.10.3, C403.11, C403.12, C404, C405, C407 and C408. The building energy cost shall be equal to or less than 85 percent of the standard reference design building.

Add new text as follows:

ASHRAE

ASHRAE
1791 Tullie Circle NE
Atlanta GA 30329

90.4-16: Energy Standard for Data Centers-

Reason: ASHRAE Standard 90.4, *Energy Standard for Data Centers*, was published in 2016 and is on continuous maintenance.

It establishes the minimum energy efficiency requirements of data centers for design and construction and for creation of a plan for operation and maintenance, and for utilization of on-site or off-site renewable energy resources.

Data center applications are unlike their commercial building counterparts in two significant ways. First, they include significantly higher plug loads (e.g., computer servers and UPS equipment). Second, they employ rapidly changing technology for the IT equipment and associated power/cooling approaches.

There is also a recognition that current industry modeling tools do not possess all the necessary mathematical models to accurately and appropriately model data center HVAC and electrical equipment design. As a result, demonstrating compliance to the 90.1 Chapter 11 or energy cost budget (ECB) approaches is usually impractical.

Along with ASHRAE 90.1, designers and owners of data centers should have the option to use ANSI/ASHRAE 90.4 as a compliance path.

Bibliography: American Society of Heating, Refrigeration, and Air Conditioning Engineers, *Energy Standard for Data Centers*, July 2016.

https://www.techstreet.com/ashrae/standards/ashrae-90-4-2016?product_id=1922463

Cost Impact: The code change proposal will increase the cost of construction
This proposal increases the costs of data centers due to its higher efficiency requirements.

Analysis: A review of the standard proposed for inclusion in the code, ASHRAE 90.4, 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.

Proposal # 4729

CE43-19

CE44-19

IECC: C401.1, C401.2, RESNET Chapter 06

Proponent: Gayathri Vijayakumar, Steven Winter Associates, Inc., representing Steven Winter Associates, Inc. (gayathri@swinter.com); Robby Schwarz, EnergyLogic, representing EnergyLogic (robby@nrglogic.com)

2018 International Energy Conservation Code

Revise as follows:

C401.1 Scope. The provisions in this chapter are applicable to commercial buildings and their building sites.

C401.2 Application. Commercial buildings shall comply with one of the following:

1. The requirements of ANSI/ASHRAE/IESNA 90.1.
2. The requirements of Sections C402 through C405 and C408. In addition, commercial buildings shall comply with Section C406 and tenant spaces shall comply with Section C406.1.1.

Exception: Dwelling units and sleeping units in Group R-2 buildings shall be deemed to be in compliance with this chapter provided they comply with the Energy Rating Index (ERI) Compliance Alternative in Section R406.

3. The requirements of Sections C402.5, C403.2, C403.3 through C403.3.2, C403.4 through C403.4.2.3, C403.5.5, C403.7, C403.8.1 through C403.8.4, C403.10.1 through C403.10.3, C403.11, C403.12, C404, C405, C407 and C408. The building energy cost shall be equal to or less than 85 percent of the standard reference design building.

Update standard(s) as follows:

RESNET

Residential Energy Services
Network, Inc.
P.O. Box 4561
Oceanside, CA 92052-4561

ANSI/RESNET/ICC ~~301—2014~~ 301—2019: Standard for the Calculation and Labeling of the Energy Performance of Low-rise Residential Buildings Dwelling and Sleeping Units using an Energy Rating Index First Published March 7, 2014—Republished January 2016

Reason: Multifamily buildings (Group R-2) have historically been split between the residential and commercial provisions of the IECC, based on their height, resulting in very different compliance requirements for similar buildings. Prior change proposals seeking to provide consistency for this building type have struggled to find a simple approach. This proposal provides a simple optional alternative for dwelling and sleeping units within these “commercial buildings” to instead meet the same energy efficiency requirements of dwelling and sleeping units under the Residential provisions, specifically section R406, the Energy Rating Index Compliance Alternative. This section R406 still requires compliance with mandatory items, including but not limited to those listed in sections R401 through R404. The other spaces in the building, such as corridors, stairwells, lobbies, community spaces, and sometimes, retail, still are required to comply with the commercial provisions. While this proposal was not possible before now, ANSI/RESNET/ICC 301-2019, which is the Standard for calculating the ERI, has recently expanded its scope to include dwelling and sleeping units in any height building, which means those units in ‘commercial buildings’ are now eligible for an ERI. While efficiency requirements can vary for the same building components, whether you are in the Residential or Commercial provisions, this is the 1st step in providing dwelling units in multifamily buildings the same path to code compliance, regardless of their building

height. This results in a dwelling unit in a 3 story building and the same exact dwelling unit in a 4 story building to both be deemed code compliant, with the same exact building components.

Cost Impact: The code change proposal will not increase or decrease the cost of construction. The cost impact depends on the code compliance currently being followed.

For those doing building simulations in accordance with C407, this may present a decrease in the costs to demonstrate compliance.

Those not choosing this alternative will experience no change in costs.

Those choosing this alternative will likely do so if they are able to utilize the same energy rating index being used in other multifamily programs, such as ENERGY STAR and LEED, or utility-sponsored incentive programs that require an ERI, as their code compliance option. This will also therefore result in no additional costs.

Proposal # 4882

CE44-19

CE45-19

IECC: C401.2, C407.3

Proponent: David Renn, PE, SE, City and County of Denver, representing Code Change Committee of Colorado Chapter of ICC (david.renn@denvergov.org)

2018 International Energy Conservation Code

Revise as follows:

C401.2 Application. Commercial buildings shall comply with one of the following:

1. The requirements of ANSI/ASHRAE/IESNA 90.1.
2. The requirements of Sections C402 through C405 and C408. In addition, commercial buildings shall comply with Section C406 and tenant spaces shall comply with Section C406.1.1.
3. The requirements of Sections C402.5, C403.2, C403.3 through C403.3.2, C403.4 through C403.4.2.3, C403.5.5, C403.7, C403.8.1 through C403.8.4, C403.10.1 through C403.10.3, C403.11, C403.12, C404, C405, C407 and C408. ~~The building energy cost shall be equal to or less than 85 percent of the standard reference design building.~~

C407.3 Performance-based compliance. Compliance based on total building performance requires that a proposed building (*proposed design*) be shown to have an annual energy cost that is less than or equal to 85 percent of 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 Price and Expenditure Report*. *Code officials* shall be permitted to require time-of-use pricing in energy cost calculations. The reduction in energy cost of the proposed design associated with *on-site renewable energy* shall be not more than 5 percent of the total energy cost. The amount of renewable energy purchased from off-site sources shall be the same in the *standard reference design* and the *proposed design*.

Exception: Jurisdictions that require site energy (1 kWh = 3413 Btu) rather than energy cost as the metric of comparison.

Reason: The third compliance option in C401.2 is for the total building performance compliance method and requires that the energy cost of the proposed design is less than or equal to 85% of the energy cost of the standard reference design, and requires compliance with C407 (and other sections). However, C407 only requires that the energy cost of the proposed design is less than or equal to the energy cost of the standard reference design. This proposal removes this apparent conflict by moving the 85% requirement to be only in C407. This is a more appropriate section for this requirement since C401.2 is a general section that should just give the required sections that must be complied with for each compliance option. There is no technical change intended by this proposal.

Cost Impact: The code change proposal will not increase or decrease the cost of construction. This proposal is only a clarification so there is no change to the cost of construction.

Proposal # 4146

CE45-19

CE46-19

IECC: C401.2, C407.2, C407.3, C407.7 (New)

Proponent: Andrew Klein, representing Self Storage Association (andrew@asklein.com)

2018 International Energy Conservation Code

Revise as follows:

C401.2 Application. Commercial buildings shall comply with one of the following:

1. The requirements of ANSI/ASHRAE/IESNA 90.1.
2. The requirements of Sections C402 through C405 and C408. In addition, commercial buildings shall comply with Section C406 and tenant spaces shall comply with Section C406.1.1.
3. The requirements of Sections C402.5, C403.2, C403.3 through C403.3.2, C403.4 through C403.4.2.3, C403.5.5, C403.7, C403.8.1 through C403.8.4, C403.10.1 through C403.10.3, C403.11, C403.12, C404, C405, C407 and C408. The building energy cost shall be equal to or less than 85 percent of the standard reference design building.
4. The requirements of Sections C407 and C408. The building energy cost shall not exceed 0 percent of the standard reference design building.

C407.2 Mandatory requirements. Compliance with this section requires compliance with Sections C402.5, C403.2, C403.3 through C403.3.2, C403.4 through C403.4.2.3, C403.5.5, C403.7, C403.8.1 through C403.8.4, C403.10.1 through C403.10.3, C403.11, C403.12, C404 and C405.

Exception: Buildings and building sites complying with Item 4 of Section C401.2.

C407.3 Performance-based compliance. Compliance based on total building performance requires that a proposed building (*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 Price and Expenditure Report*. *Code officials* shall be permitted to require time-of-use pricing in energy cost calculations. The reduction in energy cost of the proposed design associated with *on-site renewable energy* shall be not more than 5 percent of the total energy cost. The amount of renewable energy purchased from off-site sources shall be the same in the *standard reference design* and the *proposed design*.

Exception Exceptions:

1. Jurisdictions that require site energy (1 kWh = 3413 Btu) rather than energy cost as the metric of comparison.
2. When complying with Item 4 of Section C401.2, the reduction in energy cost of the proposed design associated with on-site renewable energy shall not be limited to 5 percent of the total energy cost.

Add new text as follows:

C407.7 Onsite energy storage. Compliance with Item 4 of Section C401.2 requires an onsite energy storage system with a usable capacity greater than or equal to 1/730 of the annual building energy use calculated without the contribution of on-site renewable energy.

Reason: The purpose of the IECC is the reduction of building energy use for two overall philosophical purposes: (1) reducing strain on infrastructure so that new power plants do not need to be built and (2) the

reduction of greenhouse gas emissions.

The elimination of “backstops” (e.g., minimum insulation levels, minimum equipment efficiency, etc.) is balanced with the net-zero energy requirement and the 12-hour energy storage requirement. Buildings of certain uses have shown success utilizing this net-zero energy approach, with as little as 5-year paybacks for equipment cost.

20 years in the future, when it comes time to begin replacing renewable power generators and storage systems, equipment will be even more efficient, more affordable, and more mainstream.

This approach will spur new designs and technology development that will fast track us in meeting our two overall philosophical goals: reduced grid infrastructure costs and zero greenhouse gas emissions.

Cost Impact: The code change proposal will not increase or decrease the cost of construction. This Code Change Proposal provides an alternative path.

Proposal # 5362

CE46-19

CE47-19

IECC: C105.2.6, C202 (New), C401.2, C402.5.7, C406.4, C408, C408(New), Chapter 6CE (New)

Proponent: Maureen Guttman, BCAP-IBTS, representing BCAP-IBTS (mguttman@bcapcodes.org); jim edelson, representing New Buildings Institute (jim@newbuildings.org); David Collins, representing The American Institute of Architects (dcollins@preview-group.com)

2018 International Energy Conservation Code

SECTION C202 GENERAL DEFINITIONS

Add new definition as follows:

ZERO ENERGY PERFORMANCE INDEX (zEPI₂₀₀₄). A value representative of the ratio of energy performance based on the proposed design compared to the average energy performance of a comparative baseline building (ASHRAE 90.1-2004) and its site.

SECTION C401 GENERAL

C401.1 Scope. The provisions in this chapter are applicable to commercial *buildings* and their *building sites*.

Revise as follows:

C401.2 Application. Commercial buildings shall comply with one of the following:

1. The requirements of ANSI/ASHRAE/IESNA 90.1.
2. The requirements of Sections C402 through C405 and ~~C408~~: C409. In addition, commercial buildings shall comply with Section C406 and tenant spaces shall comply with Section C406.1.1.
3. The requirements of Sections C402.5, C403.2, C403.3 through C403.3.2, C403.4 through C403.4.2.3, C403.5.5, C403.7, C403.8.1 through C403.8.4, C403.10.1 through C403.10.3, C403.11, C403.12, C404, C405, C407 and ~~C408~~: C409. The building energy cost shall be equal to or less than 85 percent of the standard reference design building.
4. The requirements of Section C408 to achieve near-net zero energy performance.

Add new text as follows:

C408 Near Net-Zero Energy Performance

C408.1 Near Net-Zero Energy Performance Performance-based designs shall demonstrate a zEPI₂₀₀₄ of 30 or below as determined in accordance with Equation xxx-1.

zEPI₂₀₀₄ = 75 x Proposed building performance/Baseline building performance (Equation xxx-1)

where:

Proposed building performance = The proposed building performance in source kBtu for the proposed design of the building and its site calculated in accordance with Section C408.1.1.

Baseline building performance = The baseline building performance in source kBtu for a baseline building and its site in accordance with Section C408.1.1.1.

75 = a fixed value representing the performance of a baseline building designed to comply with ASHRAE 90.1-2004.

C408.1.1 Modeling methodology The proposed building performance and the baseline building performance of the building and building site shall be calculated in accordance with Appendix G to ASHRAE 90.1, as modified by Sections C408.1.1.1 and C408.1.1.2. The energy use modeling shall include all energy used for building and site functions and anticipated occupancy..

C408.1.1.1 Energy units The building performance calculations in Section G3 of ASHRAE 90.1 shall be based on energy use instead of energy cost. Energy use shall be converted to consistent units by multiplying the nonrenewable energy fossil fuel use at the utility meter or measured point of delivery to Btus and multiplying by the conversion factor in Table C408.1.1.1 based on the geographical location of the building.

TABLE C408.1.1.1
ELECTRICITY GENERATION ENERGY CONVERSION FACTORS BY EPA eGRID SUB-REGION

eGRID 2010 SUB-REGION ACRONYM	eGRID 2010 SUB-REGION NAME	ENERGY CONVERSION FACTOR
<u>AKGD</u>	<u>ASCC Alaska Grid</u>	<u>3.15</u>
<u>AKMS</u>	<u>ASCC Miscellaneous</u>	<u>1.90</u>
<u>ERCT</u>	<u>ERCOT All</u>	<u>3.08</u>
<u>FRCC</u>	<u>FRCC All</u>	<u>3.26</u>
<u>HIMS</u>	<u>HICC Miscellaneous</u>	<u>3.67</u>
<u>HIOA</u>	<u>HICC Oahu</u>	<u>3.14</u>
<u>MORE</u>	<u>MRO East</u>	<u>3.50</u>
<u>MROW</u>	<u>MRO West</u>	<u>3.64</u>
<u>NYLI</u>	<u>NPCC Long Island</u>	<u>3.47</u>
<u>NEWE</u>	<u>NPCC New England</u>	<u>3.03</u>
<u>NYCW</u>	<u>NPCC NYC/Westchester</u>	<u>3.21</u>
<u>NYUP</u>	<u>NPCC Upstate NY</u>	<u>2.66</u>
<u>RFCE</u>	<u>RFC East</u>	<u>3.28</u>
<u>RFCM</u>	<u>RFC Michigan</u>	<u>3.35</u>
<u>RFCW</u>	<u>RFC West</u>	<u>3.29</u>
<u>SRMW</u>	<u>SERC Midwest</u>	<u>3.40</u>
<u>SRMV</u>	<u>SERC Mississippi Valley</u>	<u>3.20</u>
<u>SRSO</u>	<u>SERC South</u>	<u>3.20</u>
<u>SRTV</u>	<u>SERC Tennessee Valley</u>	<u>3.30</u>
<u>SRVC</u>	<u>SERC Virginia/Carolina</u>	<u>3.24</u>
<u>SPNO</u>	<u>SPP North</u>	<u>3.57</u>
<u>SPSO</u>	<u>SPP South</u>	<u>3.26</u>
<u>CAMX</u>	<u>WECC California</u>	<u>2.89</u>
<u>NWPP</u>	<u>WECC Northwest</u>	<u>2.32</u>
<u>RMPA</u>	<u>WECC Rockies</u>	<u>3.82</u>

<u>AZNM</u>	<u>WECC Southwest</u>	<u>3.10</u>
<u>None</u>	<u>Not included</u>	<u>3.15</u>

C408.1.1.2 Site to source electric power conversion. In calculating the proposed building performance and the baseline building performance, electric energy used shall be calculated in source energy by multiplying the electric power use at the utility meter or measured point of delivery in Btus by the conversion factor in Tables C408.1.1.1 and C408.1.1.2 based on the geographical location of the building.

Table C408.1.1.2
U.S. AVERAGE BUILDING FUELS ENERGY CONVERSION FACTORS BY FUEL TYPE

<u>FUEL TYPE</u>	<u>ENERGY CONVERSION FACTOR</u>
<u>Natural Gas</u>	<u>1.09</u>
<u>Fuel Oil</u>	<u>1.19</u>
<u>LPG</u>	<u>1.15</u>
<u>Purchased District Heating - Hot Water</u>	<u>1.35</u>
<u>Purchased District Heating - Steam</u>	<u>1.45</u>
<u>District Cooling</u>	<u>0.33 x value in Table C408.1.1.1</u>
<u>Other</u>	<u>1.1</u>

Revise as follows:

C105.2.6 Final inspection. The final inspection shall include verification of the installation and proper operation of all required building controls, and documentation verifying activities associated with required *building commissioning* have been conducted in accordance with Section ~~C408.~~ C409.

C402.5.7 Vestibules. Building entrances shall be protected with an enclosed vestibule, with all doors opening into and out of the vestibule equipped with self-closing devices. Vestibules shall be designed so that in passing through the vestibule it is not necessary for the interior and exterior doors to open at the same time. The installation of one or more revolving doors in the building entrance shall not eliminate the requirement that a vestibule be provided on any doors adjacent to revolving doors.

Exceptions: Vestibules are not required for the following:

1. Buildings in *Climate Zones* 1 and 2.
2. Doors not intended to be used by the public, such as doors to mechanical or electrical equipment rooms, or intended solely for employee use.
3. Doors opening directly from a *sleeping unit* or dwelling unit.
4. Doors that open directly from a space less than 3,000 square feet (298 m²) in area.
5. Revolving doors.
6. Doors used primarily to facilitate vehicular movement or material handling and adjacent personnel doors.
7. Doors that have an air curtain with a velocity of not less than 6.56 feet per second (2 m/s) at the floor that have been tested in accordance with ANSI/AMCA 220 and installed in accordance with the manufacturer's instructions. Manual or automatic controls shall be provided that will operate the air curtain with the opening and closing of the door. Air curtains and their controls shall comply with Section ~~C408.2.3.~~ C409.2.3.

C406.4 Enhanced digital lighting controls. Interior lighting in the building shall have the following enhanced

lighting controls that shall be located, scheduled and operated in accordance with Section C405.2.2.

1. Luminaires shall be configured for continuous dimming.
2. Luminaires shall be addressed individually. Where individual addressability is not available for the luminaire class type, a controlled group of not more than four luminaries shall be allowed.
3. Not more than eight luminaires shall be controlled together in a *daylight zone*.
4. Fixtures shall be controlled through a digital control system that includes the following function:
 - 4.1. Control reconfiguration based on digital addressability.
 - 4.2. Load shedding.
 - 4.3. Individual user control of overhead general illumination in open offices.
 - 4.4. Occupancy sensors shall be capable of being reconfigured through the digital control system.
5. Construction documents shall include submittal of a Sequence of Operations, including a specification outlining each of the functions in Item 4.
6. Functional testing of lighting controls shall comply with Section ~~C408~~ C409.

SECTION ~~C408~~ C409

MAINTENANCE INFORMATION AND SYSTEM COMMISSIONING

Add new standard(s) as follows:

ASHRAE

ASHRAE
1791 Tullie Circle NE
Atlanta GA 30329

90.1 - 2004: Energy Standard for Buildings Except Low-rise Residential Buildings

Reason: This proposal adds a compliance option for projects or jurisdictions striving for a near net-zero energy performance metric.

The zEPI methodology was created by Charles Eley and first introduced to codes in the *International Green Construction Code*. It served as a means of calculating energy performance modeling that would simplify the ability of moving the IgCC energy performance target to net zero energy within several code cycles. With the technical content of the IgCC now being developed by ASHRAE 189.1, this unique approach has been lost.

zEPI points to a unit on a scale that goes from a theoretical 100 to zero, where 100 equals actual performance for existing buildings as identified in the 2003 CBECS database. The 75 on that scale is a fixed number representing the energy performance level of the ASHRAE 90.1-2004, which is the baseline model using ASHRAE Appendix G.

The zEPI target in this proposal is 30 or below, which represents an energy performance level that is 70% better in terms of energy efficiency/conservation than a 2013 CBECS building. Based on data from many built "net zero" and Passive House buildings, 30 is a reasonable target for the building envelope and systems, where the remaining energy consumed by the building can be accommodated with on-site renewables in many climate and insolation zones.

The section has been added to Chapter CE 4 as Section C408, renumbering the existing C408 (Maintenance Information and System Commissioning) and all related subsections to C409. References to this section have been edited accordingly.

Cost Impact: The code change proposal will not increase or decrease the cost of construction. It is a compliance option for projects or jurisdictions seeking a higher level of energy performance than the base

code. Even if selected, many projects have been designed and built using a near net-zero energy goal at no increase in cost over conventional energy performance goals.

Analysis: The referenced standard, ASHRAE 90.1-2004 was previously referenced in the 2006 edition of the IECC, but is not currently referenced in other 2018 I-codes.

Proposal # 5598

CE47-19

CE48-19

IECC: C401.2, C407.2

Proponent: David Renn, PE, SE, City and County of Denver, representing Code Change Committee of Colorado Chapter of ICC (david.renn@denvergov.org)

2018 International Energy Conservation Code

Revise as follows:

C401.2 Application. Commercial buildings shall comply with one of the following:

1. The requirements of ANSI/ASHRAE/IESNA 90.1.
2. The requirements of Sections C402 through C405 and C408. In addition, commercial buildings shall comply with Section C406 and tenant spaces shall comply with Section C406.1.1.
3. The requirements of Sections ~~C402.5, C403.2, C403.3 through C403.3.2, C403.4 through C403.4.2.3, C403.5.5, C403.7, C403.8.1 through C403.8.4, C403.10.1 through C403.10.3, C403.11, C403.12, C404, C405, C407 and C408.~~ The building energy cost shall be equal to or less than 85 percent of the standard reference design building.

C407.2 Mandatory requirements. Compliance with this section requires compliance with Sections C402.5, C403.2, C403.3 through C403.3.2, C403.4 through C403.4.2.3, C403.5.5, C403.7, C403.8.1 through C403.8.4, C403.10.1 through C403.10.3, C403.11, C403.12, C404 and C405.

Reason: This proposal is intended to simplify the code by providing mandatory requirements of the Total Building Performance method in one location only. Currently, the third compliance method in the general application section C401.2 lists all of the mandatory sections that are required for the Total Building Performance method, and also requires compliance with C407 and C408. Then, these same mandatory sections are given in C407.2. There is no need to have these requirements in the code in two locations and this proposal locates them only as a specific requirement of the C407 for the Total Building Performance method. By giving these requirements in one location only, it reduces the risk of changes being made in one section without updating the other section.

Cost Impact: The code change proposal will not increase or decrease the cost of construction. This proposal is a simplification of the code without any technical change, so cost of construction will not change.

Proposal # 4149

CE48-19

CE49-19

IECC: C401.2, C407.3

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:

C401.2 Application. Commercial buildings shall comply with one of the following:

1. The requirements of ANSI/ASHRAE/IESNA 90.1.
2. The requirements of Sections C402 through C405 and C408. In addition, commercial buildings shall comply with Section C406 and tenant spaces shall comply with Section C406.1.1.
3. The requirements of Sections C402.5, C403.2, C403.3 through C403.3.2, C403.4 through C403.4.2.3, C403.5.5, C403.7, C403.8.1 through C403.8.4, C403.10.1 through C403.10.3, C403.11, C403.12, C404, C405, C407 and C408. The building energy cost shall be equal to or less than ~~85~~ 80 percent of the standard reference design building.

C407.3 Performance-based compliance. Compliance based on total building performance requires that a proposed building (*proposed design*) be shown to have an annual energy cost that is less than or equal to 80 percent of 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 Price and Expenditure Report*. *Code officials* shall be permitted to require time-of-use pricing in energy cost calculations. The reduction in energy cost of the proposed design associated with *on-site renewable energy* shall be not more than 5 percent of the total energy cost. The amount of renewable energy purchased from off-site sources shall be the same in the *standard reference design* and the *proposed design*.

Exception: Jurisdictions that require site energy (1 kWh = 3413 Btu) rather than energy cost as the metric of comparison.

Reason: The purpose of this code change proposal is to improve the efficiency of buildings designed to comply under the IECC performance path by altering the multiplier for the standard reference design building from 85% to 80%. Starting with the 2012 IECC, rather than undertake a complete retooling of the performance path, advocates added a percentage multiplier to the standard reference design to reduce the energy budget for the baseline. This approach provided maximum flexibility to the code user. Improvements could be made to any part of the building to achieve the 15% improvement. This approach also established a means of easily updating the performance path in the future: As additional efficiency is needed, the multiplier can be lowered to meet those needs.

Since the 2012 IECC, the 85% multiplier has not been changed, even though other parts of the commercial IECC have undergone improvements. This proposal updates the multiplier by essentially improving efficiency by about 5% (as compared to the original baseline code, the 2009 IECC).

This proposal also includes the same multiplier in Section C407.3. We believe this is a more appropriate place for the multiplier, since it is closer to the other assumptions included in the standard reference design. However, we would prefer to see it included in both C407.3 and C401.2 to make sure that code users understand the requirements of the performance path.

Cost Impact: The code change proposal will increase the cost of construction. Adding additional efficiency measures will increase construction cost. However, we expect that design professionals and builders will select the improvements that are the most cost-effective and the easiest to implement into specific designs.

Proposal # 4460

CE49-19

CE50-19

IECC: C401.2.1, C402.4.3.4

Proponent: Thomas D. Culp, Ph.D., Birch Point Consulting LLC, representing the Glazing Industry Code Committee and the Aluminum Extruders Council (culp@birchpointconsulting.com)

2018 International Energy Conservation Code

Revise as follows:

C401.2.1 Application to replacement fenestration products. 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* in Table C402.4.

Exception: An area-weighted average of the *U*-factor of replacement fenestration products being installed in the building ~~for each fenestration product category listed in Table C402.4~~ shall be permitted to satisfy the *U*-factor requirements of Table C402.4. The combined area-weighted average *U*-factor calculated using the respective area for each fenestration product category listed in Table C402.4. Individual fenestration products from different product categories listed in Table C402.4 shall not be combined in calculating the area-weighted average *U*-factor. equal to or less than the combined area-weighted average *U*-factor calculated using the *U*-factors from Table C402.4 with the same fenestration area and product types.

C402.4.3.4 Area-weighted *U*-factor. An area-weighted average shall be permitted to satisfy the *U*-factor requirements of Table C402.4. The combined area-weighted average *U*-factor calculated using the respective area for each fenestration product category listed in Table C402.4. Individual fenestration products from different fenestration product categories listed in Table C402.4 shall not be combined in calculating area-weighted average *U*-factor. equal to or less than the combined area-weighted average *U*-factor calculated using the *U*-factors from Table C402.4 with the same fenestration area and product types.

Reason: The purpose of this proposal is to clarify the area-weighted averaging of *U*-factor for fenestration products and make it consistent with other parts of the code. The current language includes a sentence that says fenestration products from different product categories listed in Table C402.4 shall not be combined in area-weighted averages, such as fixed and operable windows. However, this is inconsistent with other parts of the code. Section C402.1.5 permits it through Factor A of Equation 4-2 for the commercial energy code, and Sections R402.1.5 and R402.3.1 permit it for fenestration and all envelope components in the residential energy code. Furthermore, there is no technical reason they should not be combined for calculating area-weighted average *U*-factor.

As a practical example, in curtain wall, higher *U*-factors of operable commercial awning/vent products can be compensated for by lower *U*-factors of the main fixed window area, with the same overall performance of the facade. If this section is not corrected, it could inadvertently restrict flexibility for the designer, and also potentially discourage the use of operable products for natural ventilation, as casements and vents have a more difficult time complying with the prescriptive *U*-factors than sliding or fixed windows. Therefore, this proposal is necessary for practical considerations as well as clarification and consistency with other parts of the code. At the same time, this proposal also clarifies how the average is calculated and compared to the baseline prescriptive requirements. Finally, in response to public comments and discussion last cycle, this proposal does not include area-weighted averaging of *SHGC*.

(Note: if section C402.1.2.1 is moved to chapter 5 by other proposals, our intent is that the same changes in this proposal also be included in the section moved to chapter 5.)

Cost Impact: The code change proposal will not increase or decrease the cost of construction. This proposal simply clarifies the use of area-weighted averaging of fenestration product *U*-factors, and does

not impact cost of construction.

Proposal # 4752

CE50-19

CE51-19 Part I

PART I — IECC: C401.2 (New), C401.2, C407.2, SECTION C408

PART II — IECC: R401.2 (IRC N1101.6) (New), R401.2 (IRC N1101.13), R405.2 (IRC N1105.2), R406.2 (IRC N1106.2)

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

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

2018 International Energy Conservation Code

Add new text as follows:

C401.2 Mandatory and Prescriptive. Provisions labeled as "Mandatory" are required using any compliance option. Provisions labeled "Prescriptive" are only required when complying with Item 2 of Section C401.3. Charging section labels apply to unlabeled subsections.

Revise as follows:

~~C401.2~~ **C401.3 Application.** Commercial buildings shall comply with one of the following:

1. The requirements of ANSI/ASHRAE/IESNA 90.1.
2. The requirements of Sections C402 through ~~C405~~ C406 and C408. ~~In addition, commercial buildings shall comply with Section C406 and tenant spaces shall comply with Section C406.1.1.~~
3. The requirements of ~~Sections~~ Section C407. ~~C402.5, C403.2, C403.3 through C403.3.2, C403.4 through C403.4.2.3, C403.5.5, C403.7, C403.8.1 through C403.8.4, C403.10.1 through C403.10.3, C403.11, C403.12, C404, C405, C407 and C408.~~ The building energy cost shall be equal to or less than 85 percent of the standard reference design building.

Delete without substitution:

~~**C407.2 Mandatory requirements.** Compliance with this section requires compliance with Sections C402.5, C403.2, C403.3 through C403.3.2, C403.4 through C403.4.2.3, C403.5.5, C403.7, C403.8.1 through C403.8.4, C403.10.1 through C403.10.3, C403.11, C403.12, C404 and C405.~~

Revise as follows:

SECTION C408 MAINTENANCE INFORMATION AND SYSTEM COMMISSIONING (MANDATORY)

Proposal # 4702

CE51-19 Part I

CE51-19 Part II

IECC: R401.2 (IRC N1101.6) (New), R401.2 (IRC N1101.13), R405.2 (IRC N1105.2), R406.2 (IRC N1106.2)

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:

R401.1 Scope. This chapter applies to residential buildings.

Add new text as follows:

R401.2 (IRC N1101.6) Mandatory and Prescriptive Provisions labeled as "Mandatory" are required using any compliance option. Provisions labeled "Prescriptive" are only required when complying with Item 1 of Section R401.2. Charging section labels apply to unlabeled subsections.

Revise as follows:

~~**R401.2 (IRC N1101.13)**~~ **R401.3 (IRC N1101.14) 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.

~~**R405.2 (IRC N1105.2) Mandatory requirements.**~~ **Supply and Return Ducts (Mandatory).** 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) Thermal envelope (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 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> (<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 makes no additions nor deletions to the technical provisions of the code and has no impact on design or construction.

CE52-19

IECC: C401.2.1, C402.4.3.4

Proponent: Tom Zaremba, Roetzel & Andress, representing Self (tzaremba@ralaw.com)

2018 International Energy Conservation Code

Revise as follows:

C401.2.1 Application to replacement fenestration products. 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* in Table C402.4.

Exception: An area-weighted average of the *U*-factor and *SHGC* of replacement fenestration products being installed in the building for each fenestration product category listed in Table C402.4 shall be permitted to satisfy the *U*-factor and *SHGC* requirements of Table C402.4. The combined area-weighted average *U*-factor calculated using the respective area for each fenestration product category listed in Table C402.4. Individual fenestration products from different product categories listed in Table C402.4 Table C402.4 shall be equal to or less than the combined area-weighted average *U*-factor calculated using the *U*-factors from Table C402.4 with the same fenestration area and product types. Area-weighted average *SHGC* shall only be calculated for *vertical fenestration* facing within 45 degrees of each cardinal direction and shall be equal to or less than the area-weighted average *SHGC* calculated using the *SHGC* from Table C402.4 with the same fenestration area and orientation. *Vertical fenestration* and *skylights* shall not be combined in calculating the area-weighted average *U*-factor *SHGC*.

C402.4.3.4 Area-weighted *U*-factor, factor and *SHGC*. An area-weighted average shall be permitted to satisfy the *U*-factor and *SHGC* requirements of Table C402.4. The combined area-weighted average *U*-factor calculated using the respective area for each fenestration product category listed in Table C402.4. Individual fenestration products from different fenestration product categories listed in Table C402.4 C402.4 shall be equal to or less than the combined area-weighted average *U*-factor calculated using the *U*-factors from Table C402.4 with the same fenestration area and product types. Area-weighted average *SHGC* shall only be calculated for *vertical fenestration* facing within 45 degrees of each cardinal direction and shall be equal to or less than the area-weighted average *SHGC* calculated using the *SHGC* from Table C402.4 with the same fenestration area and orientation. *Vertical fenestration* and *skylights* shall not be combined in calculating area-weighted average *U*-factor. *SHGC*.

Reason: This proposal clarifies the area-weighted averaging of fenestration product properties for prescriptive compliance, and provides consistency with other parts of the code. Last cycle, a similar proposal passed the code development committee by a vote of 11-1, but failed in the final vote as a result of misunderstanding about (a) how to calculate the baseline for comparison, and (b) how the *SHGC* of products facing different directions should be handled. Both of these concerns have been addressed in this proposal.

Area-weighted averaging of *U*-factor of all fenestration products is already included in Section C402.1.5 through Factor A of Equation 4-2 for the commercial energy code, and in Sections R402.1.5 and R402.3.1 for the residential energy code, so it makes sense to allow averaging of all products here too. To address prior concerns, additional detail was added to the wording on how the area-weighted average *U*-factor is calculated and compared to the baseline prescriptive requirements.

For *SHGC*, Section R402.3.2 allows area-weighted averaging of *SHGC* of all products for the residential code. For the commercial code, the IECC code development body indicated in previous cycles that products facing different directions, e.g. north and west, should not be combined. However, there is no technical reason to not allow averaging of *SHGC* as long as it is limited by orientation and vertical vs. skylight. Therefore, *SHGC* averaging is included here, and to address concerns from last cycle, the wording was made more specific such

as only allowing products facing within 45 degrees of each cardinal direction to be combined.

Cost Impact: The code change proposal will not increase or decrease the cost of construction. This proposal only addresses the option to use area-weighted averaging of fenestration product U-factors and SHGC, and does not impact cost of construction.

Proposal # 4816

CE52-19

CE53-19

IECC: C202(New), C401.2.2(New), C406.5

Proponent: jim edelson, representing New Buildings Institute (jim@newbuildings.org)

2018 International Energy Conservation Code

Add new text as follows:

Renewable Energy Certificate (REC). An instrument that represents the environmental attributes of one megawatt-hour of renewable electricity; also known as an energy attribute certificate (EAC).

C401.2.2 On-site renewable energy Each building site shall have equipment for on-site renewable energy with a rated capacity of not less than 0.25 W/ft² (2.7 W/m²) multiplied by the sum of the gross conditioned floor area of the three largest floors. Documentation shall be provided to the code official that indicates that renewable energy certificates (RECs) associated with the on-site renewable energy will be retained and retired by or on behalf of the owner or tenant.

Exceptions:

1. Any building located where an unshaded flat plate collector oriented towards the equator and tilted at an angle from horizontal equal to the latitude receives an annual daily average incident solar radiation less than 3.5 kWh/m²·day (1.1 kBtu/ft²·day).
2. Any building where more than 80 percent of the roof area is covered by any combination of equipment other than for on-site renewable energy systems, planters, vegetated space, skylights or occupied roof deck.
3. Any building where more than 50 percent of roof area is shaded from direct-beam sunlight by natural objects or by structures that are not part of the building for more than 2,500 annual hours between 8:00 AM and 4:00 PM.

Revise as follows:

C406.5 On-site renewable energy. The total minimum ratings of *on-site renewable energy* systems, not including *on-site renewable energy* system capacity used for compliance with Section C401.2.2, shall be one of the following:

1. Not less than 1.71 Btu/h per square foot (5.4 W/m²) or 0.50 watts per square foot (5.4 W/m²) of conditioned floor area.
2. Not less than 3 percent of the energy used within the building for building mechanical and service water heating equipment and lighting regulated in Chapter 4.

Reason: Onsite renewable energy installations are becoming widespread in many parts of the country, and mandatory in other parts. This proposal creates a mandatory requirement for a system that is approximately one-half of the capacity that has been a compliance package selection in Section 406 since the 2012 IECC. This language is largely based on Addendum “by” now pending to modify ASHRAE 90.1-2016. The three exceptions are written to ensure that the requirement is not being applied to buildings without adequate space on the roof, to buildings that are in areas of the country where unblocked insolation levels do not provide enough energy to make the equipment cost-effective (according to ASHRAE cost-effective criteria), and to buildings where solar access is wholly or partially blocked. The economic analysis supporting the Addendum is what was used to derive the specifications in the measure’s exceptions. The analysis included multi-variate calculations on the PNNL 3-Story Medium Office Bldg Prototype and modeled @ 0.25W/SF of renewable capacity for conditioned area on all 3 floors. The solar equipment on the prototype models passed the ASHRAE

Economic Scalar in 5 of 6 insulation zones. The sixth zone aligns with the third exception in the proposal .

Section 406.5 is modified so that the renewable capacity used for compliance with the new minimum requirement is not also counted towards compliance with Section 406.

The proposal also ensures that renewable energy used for compliance with another obligation (eg. through the transfer of RECs then applied to a state Renewable Portfolio Standard) is not double counted towards compliance with the IECC. While this proposal does not cite Green-E, the Green-E Standard describes how double counting occurs when RECs associated with an on-site system have been transferred to another party in the transaction for the onsite renewable system (such as a lease or financing contract) and are then counted towards code compliance:

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.*

Bibliography: Addendum *by* to Standard 90.1-2016, Energy Standard for Buildings Except Low-Rise Residential Buildings; ASHRAE, January 2018. (pending at the time of submittal)
Green-e Renewable Energy Standard for Canada and the United States, Version 3.2; March 20, 2018.

Cost Impact: The code change proposal will increase the cost of construction
The representative average price for onsite renewable energy systems as analyzed in 2018 by the ASHRAE 90.1 working group was \$2.50 per installed watt of capacity, before incentives. The workgroup also indicated that the required capacity levels were cost-effective, according to ASHRAE criteria, for buildings in the areas that were subject to the requirement (i.e. not excepted from the requirement).

Proposal # 4967

CE53-19

CE54-19 Part I

PART I — IECC: C401.2, C401.3 (New), C401.3.1.1 (New), C401.3.2 (New)

PART II — IECC: R401.2, R401.2.1 (IRC N1101.13.1) (New), R401.2.1.1 (IRC N1101.13.1.1) (New), R401.2.1.2 (IRC N1101.13.1.2) (New)

Proponent: Craig Conner, representing self (craig.conner@mac.com)

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

2018 International Energy Conservation Code

Revise as follows:

C401.2 Application. Commercial buildings shall comply with one of the following:

1. The requirements of ANSI/ASHRAE/IESNA 90.1. 2.
2. The requirements of Sections C402 through C405 and C408. In addition, commercial buildings shall comply with Section C406 and tenant spaces shall comply with Section C406.1.1.
3. The requirements of Sections C402.5, C403.2, C403.3 through C403.3.2, C403.4 through C403.4.2.3, C403.5.5, C403.7, C403.8.1 through C403.8.4, C403.10.1 through C403.10.3, C403.11, C403.12, C404, C405, C407 and C408. The building energy cost shall be equal to or less than 85 percent of the standard reference design building.
4. Tropical zone alternative in C401.3

Add new text as follows:

C401.3 Tropical zone alternative. Group R-2 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 where the conditions of either Section C401.3.1 or C401.3.2 are met.

C401.3.1.1 Limited air-conditioning option. Where a portion of the dwelling unit is provided with air-conditioning, all the following shall be 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 0.30, 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 unvented.
7. Roof surfaces have a slope of not less than one-fourth 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.

C401.3.2 Dwelling units without air-conditioning option. Where none of the occupied space is air conditioned or heated, all of the following shall be met:

1. There are no requirements for glazing U-factor, SHGC or air tightness.
2. Permanently installed lighting is in accordance with Section R404.
3. The exterior roof and wall surfaces have an 0.85 initial and 0.70 aged reflectivity or have insulation with an R-value of R-5 or greater.
4. Roof surfaces have a slope of not less than one-fourth unit vertical in 12 units horizontal (21-percent slope). The finished roof does not have water accumulation areas.
5. Operable fenestration provides ventilation in each room. There shall be at least one window per face of the dwelling unit.
6. Bedrooms with exterior walls facing two different directions have operable fenestration on exterior walls facing two directions.
7. Interior doors to bedrooms are capable of being secured in the open position.
8. Ceiling fans are provided in at least one bedroom and in the largest space that is not used as a bedroom.

Proposal # 5633

CE54-19 Part I

CE54-19 Part II

IECC: R401.2, R401.2.1 (IRC N1101.13.1) (New), R401.2.1.1 (IRC N1101.13.1.1) (New), R401.2.1.2 (IRC N1101.13.1.2) (New)

Proponent: Craig Conner, representing self (craig.conner@mac.com)

2018 International Energy Conservation Code

R401.2 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 tropical zone alternative in accordance with Section R401.2.1.

Revise as follows:

R401.2.1 (IRC N1101.13.1) 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 where~~ the following conditions ~~of either Section R401.2.1.1 or R401.2.1.2~~ 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 unvented.~~
7. ~~Roof surfaces have a slope of not less than one-fourth 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.~~

R401.2.1.1 (IRC N1101.13.1.1) Limited air-conditioning option. Where a portion of the dwelling unit is provided with air-conditioning, all of the following shall be 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 unvented.

7. Roof surfaces have a slope of not less than one-fourth 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.

Add new text as follows:

R401.2.1.2 (IRC N1101.13.1.2) Dwelling units without air-conditioning option. Where none of the occupied space of the dwelling unit is air-conditioned or heated, all of the following shall be met:

1. There are no requirements for glazing U-factor, SHGC or air tightness.
2. Permanently installed lighting is in accordance with Section R404.
3. The exterior roof and wall surfaces shall have an 0.85 initial and 0.70 aged reflectivity or have insulation with an R-value of R-5 or greater.
4. Roof surfaces have a slope of not less than one-fourth unit vertical in 12 units horizontal (21-percent slope). The finished roof does not have water accumulation areas.
5. Operable fenestration provides ventilation in each room. There shall be at least one window per face of the dwelling unit.
6. Bedrooms with exterior walls facing two different directions have operable fenestration on exterior walls facing two directions.
7. Interior doors to bedrooms are capable of being secured in the open position.
8. Ceiling fans are provided for a bedroom and the largest space that is not used as a bedroom.

Reason: This change provides a very low-income option which achieves energy savings primarily by having no air conditioning and no heating which yields a very low energy residence compared to the code home. This new option includes reflective ceilings, walls, and fans. Cooling is provided by ventilation and ceiling fans. Without this option many of the low income Puerto Rico residences will be building 'informally', which translates to outside the code.

Cost Impact: The code change proposal will not increase or decrease the cost of construction. This provides an alternative to "informal" housing which is built outside the code. Mainland style air tightness, windows, and even the HVAC systems are not appropriate to this housing. How do you access the costs for housing that is not built under the code now?

Staff Analysis: Please note that due to the requirements of the cdpACCESS system, where a new subsection is created and is populated with existing text, the existing text must be shown as removed from the existing section and shown as new in the new section. The 11 items in the new section R401.2.1.1 are the 11 items in the current code. They are simply relocated.

Proposal # 5640

CE54-19 Part II

CE55-19

IECC C401.3(New)

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

Add new text as follows:

C401.3 Thermal envelope certificate (Mandatory). A permanent thermal envelope certificate shall be completed by an *approved* party. Such certificate shall be posted on a wall in the space where the space conditioning equipment is located, a utility room or other *approved* location. If 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. A copy of the certificate shall also be included in the construction files for the project. The certificate shall include:

1. R-values of insulation installed in or on ceilings, roofs, walls, foundations and slabs, *basement walls*, crawl space walls and floors and ducts outside *conditioned spaces*;
2. U-factors and solar heat gain coefficients (SHGC) of fenestration;
3. Results from any *building envelope* air leakage testing performed on the *building*

Where there is more than one value for any component of the building envelope, the certificate shall indicate the area-weighted average value where available. If the area-weighted average is not available, the certificate shall list each value that applies to 10% or more of the total component area.

Reason: The purpose of this code change proposal is to add a permanent certificate to commercial buildings that will record basic information related to the building thermal envelope. This is similar to the requirement for residential buildings in Section R401.3, which has been in the IECC since at least the 2006 edition and has been successfully integrated into software programs such as REScheck. A significant percentage of commercial buildings will undergo system commissioning under Section C408, which will include documentation of mechanical and lighting systems. However, there is no similar requirement or documentation for the building's thermal envelope components. We acknowledge that the commercial provisions of the IECC are intended to cover an extremely broad range of commercial buildings, so the certificate requirement has been simplified to cover only the basic elements of the thermal envelope.

The information contained in this certificate will be readily available at construction, but as the building ages and ownership is transferred, some of this critical information could be lost. As future owners or lessors undertake load calculations for HVAC sizing or other measures that require a working knowledge of the building's thermal envelope characteristics, this information will be important. Recording the information in a permanent manner in an approved location at the building, as well as including documentation in the construction files for the project would not be overly burdensome but would provide valuable information to future building owners.

Cost Impact: The code change proposal will not increase or decrease the cost of construction. The information required to be included in the thermal envelope certificate will be readily available at construction and can be easily integrated into compliance software. This same information could be difficult to obtain several years down the road and recording it at construction will save future owners and lessors of a commercial building both time and money.

Proposal # 5065

CE55-19

CE56-19

IECC: 202, 202, 202 (New), C402.1.1, 402.1.1.1 (New), TABLE C402.1.1.1 (New)

Proponent: Nicholas O'Neil, NW Energy Codes Group, representing NW Energy Codes Group
(noneil@energy350.com)

2018 International Energy Conservation Code

FENESTRATION. Products classified as either skylights or vertical fenestration.

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, greenhouses, and sloped walls.

Vertical fenestration Windows that are fixed or operable, opaque doors, glazed doors, glazed block and combination opaque and 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.

Revise as follows:

GREENHOUSE. A structure or a thermally isolated area of a building that maintains a specialized sunlit environment exclusively used for, and essential to, the cultivation, protection or maintenance of plants. Greenhouses are those that are erected for a period of 180 days or more.

Add new definition as follows:

INTERNAL CURTAIN SYSTEM. An internal curtain system consists of moveable panels of fabric or plastic film used to cover and uncover the space enclosed in a greenhouse on a daily basis.

Revise as follows:

C402.1.1 Low-energy buildings and greenhouses. 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 C402.

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 per square foot (10.7 W/m²) of floor area for space conditioning purposes.
2. Those that do not contain *conditioned space*.
3. ~~Greenhouses.~~

Add new text as follows:

402.1.1.1 Greenhouses Greenhouse structures or areas that are mechanically heated or cooled and that comply with all of the following shall be exempt from the building envelope requirements of this code:

1. Exterior opaque envelope assemblies comply with Sections C402.2 and C402.4.5.

Exception: Low energy greenhouses that comply with Section C402.1.1.

2. Interior partition building thermal envelope assemblies that separate the greenhouse from conditioned space comply with Sections C402.2, C402.4.3 and C402.4.5.
3. Fenestration assemblies that comply with the thermal envelope requirements in Table C402.1.1.1. The U-factor for a roof shall be for the roof assembly or a roof that includes the

assembly and an *internal curtain system*.

Exception: Unconditioned *greenhouses*.

TABLE C402.1.1.1
FENESTRATION THERMAL ENVELOPE MAXIMUM REQUIREMENTS

Component	U-factor (BTU/h-ft²-°F)
Skylight	0.5
Vertical fenestration	0.7

Reason: Greenhouses are currently exempt from the energy code through the low-energy building path even though they can use substantial amounts of energy. This proposal places commonplace envelope requirements on the structure when it is being mechanically heated or cooled. Low-energy use greenhouses structures are still exempt if they have a low energy usage per square foot in line with C402.1.1.

Cost Impact: The code change proposal will increase the cost of construction. Costs of \$1.27/sqft are based on a one-time installation cost of double IR poly-film at \$0.10/sqft and a thermal curtain at \$1.17/sqft. These costs are based on product offerings and utility rebate program findings. Total size of greenhouse assumed to be an average size single bay with dimensions of 35 feet wide, 100 feet long, 4-foot sidewalls and 14-foot total ceiling height.

Proposal # 4674

CE56-19

CE57-19

IECC C402.1.1

Proponent: Steven Rosenstock, Edison Electric Institute, representing Edison Electric Institute
(srosenstock@eei.org)

2018 International Energy Conservation Code

Revise as follows:

C402.1.1 Low-energy buildings. 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 C402.

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 per square foot (10.7 W/m²) of floor area for space conditioning purposes.
2. Those that do not contain *conditioned space*.
3. Greenhouses.
4. Buildings with a floor area not greater than 1,100 square feet (102.2 square meters) in size and solely used to house electric distribution system equipment.

Reason: These buildings are used to house electric distribution equipment, not people. They are equipment sheds or equipment vaults. Any space conditioning installed is only meant to prevent damage to equipment due to extreme weather or storms. The amount of time that people work in these buildings (for maintenance or testing or repair) is minimal.

Based on feedback from EEI member companies, anywhere from 50% to 100% of utility vaults or enclosed switching stations or substations are not conditioned at all. For electric equipment buildings that are conditioned, the temperature settings are typically much higher in the summer (85 degrees F or higher) and much lower in the winter (60 degrees F or lower) than spaces that are meant for human comfort to be maintained on a regular basis.

Some of the electric equipment vaults being used by utilities are as large as 18 feet by 60 feet, or 1,080 square feet. The size limit of 1,100 square feet will ensure that the exemption is limited to these types of buildings.

Bibliography: Specifications for vaults from different utilities can be found at the following web site links:
<https://www.coned.com/-/media/files/coned/documents/es/specs/electricbluebook.pdf>

<https://www.smud.org/-/media/Documents/Business-Solutions-and-Rebates/PDFs/Customer-Built-Vaults.ashx?la=en&hash=ACE6D4512846A1FC65A8A37EEE224AC31C2791BF>

https://www.nationalgridus.com/media/pronet/constr_esb754759.pdf

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

This proposal is adding an exemption to the envelope requirements of Section Chapter 4, and as a result, will decrease the cost of construction for these low energy buildings.

Proposal # 4218

CE57-19

CE58-19

IECC: C402.1.2

Proponent: Steven Rosenstock, Edison Electric Institute, representing Edison Electric Institute
(srosenstock@eei.org)

2018 International Energy Conservation Code

Revise as follows:

C402.1.2 Equipment buildings. Buildings that comply with the following shall be exempt from the *building thermal envelope* provisions of this code:

1. Are separate buildings with floor area not more than ~~500-1,200~~ square feet (~~50-110~~ m²).
2. Are intended to house ~~electronic~~ electric equipment with installed equipment power totaling not less than 7 watts per square foot (75 W/m²) and not intended for human occupancy.
3. Have a heating system capacity not greater than (17,000 Btu/hr) (5 kW) and a heating thermostat setpoint that is restricted to not more than 50°F (10°C).
4. Have an average wall and roof *U*-factor less than 0.200 in *Climate Zones* 1 through 5 and less than 0.120 in *Climate Zones* 6 through 8.
5. Comply with the roof solar reflectance and thermal emittance provisions for *Climate Zone* 1.

Reason: There are many buildings that are used to house electric distribution equipment, not people. They are equipment sheds or equipment vaults. Any space conditioning installed is only meant to prevent damage to equipment due to extreme weather or storms. The amount of time that people work in these buildings (for maintenance or testing or repair) is minimal.

Based on feedback from EEI member companies, anywhere from 50% to 100% of utility vaults or enclosed switching stations or substations are not conditioned at all. They would qualify for this exception.

Some of the electric equipment vaults being used by utilities are as large as 18 feet by 60 feet, or 1,080 square feet. The size limit of 1,200 square feet will ensure that the exemption is limited to these types of buildings.

The other change, from "electronic" to "electric" is editorial and designed to prevent any confusion as to what types of equipment qualify for this section (e.g., a transformer vault has electric equipment that may be considered to be different from "electronic" equipment).

Bibliography: Specifications for vaults from from different utilities can be found at the following web site links:
<https://www.coned.com/-/media/files/coned/documents/es/specs/electricbluebook.pdf>

<https://www.smud.org/-/media/Documents/Business-Solutions-and-Rebates/PDFs/Customer-Built-Vaults.ashx?la=en&hash=ACE6D4512846A1FC65A8A37EEE224AC31C2791BF>

https://www.nationalgridus.com/media/pronet/constr_esb754759.pdf

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

This proposal reduces the envelope requirements for these types of equipment buildings in Chapter 4, and as a result, will decrease the cost of construction for these low energy buildings.

Proposal # 5151

CE58-19

CE59-19

IECC: C402.1.3 (New), C402.1.3.1(New), C402.1.3.2(New)

Proponent: Andrew Klein, representing the Self Storage Association (andrew@asklein.com)

2018 International Energy Conservation Code

Add new text as follows:

C402.1.3 Low occupancy buildings Group S and and Group U occupancy buildings shall be permitted to have a thermal performance in accordance with Sections C402.1.3.1 and C402.1.3.2.

Exception: Refrigerated warehouses.

C402.1.3.1 R-value-based method Opaque thermal envelope insulation components shall be not less than 65% of the values specified in Table C402.1.3 for commercial buildings.

C402.1.3.2 U-factor-based method Opaque thermal envelope assemblies shall be not greater than 150% of the values specified in Table C402.1.4 for commercial buildings.

Reason: This Code Change Proposal recognizes that building energy use is dependent upon more than whether a building is conditioned or non-conditioned-the use of the building has a greater impact. ASHRAE 90.1 recognizes that higher insulation levels are not always cost-justified and has a category of reduced thermal insulation requirements for "semi-heated buildings."

This code change proposal simplifies the application of those provisions by identifying the building occupancies that have low occupancies (low ventilation requirements) and often have high thermal masses of contents, resulting in low energy use for space conditioning. The R-values and U-factors are aligned closely with the insulation values in the 2006 edition of the IECC.

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

This code change proposal will reduce the cost of constuction for many Group S and U occupancies.

Proposal # 5474

CE59-19

CE60-19 Part I

PART I — IECC: C402.1.3

PART II — IECC: R202 (IRC N1101.6), R402.1.3 (IRC N1102.1.3)

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

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

2018 International Energy Conservation Code

Revise as follows:

C402.1.3 Insulation component *R*-value-based method. Building thermal envelope opaque assemblies shall comply with the requirements of Sections C402.2 and C402.4 based on the climate zone specified in Chapter 3. For opaque portions of the building thermal envelope intended to comply on an insulation component R-value basis, the ~~*R*-values~~ R-values for cavity insulation and continuous insulation shall be not less than that specified in Table C402.1.3. Where cavity insulation is installed in multiple layers, the cavity insulation R-values shall be summed to determine compliance with the cavity insulation R-value requirements. Where continuous insulation is installed in multiple layers, the continuous insulation R-values shall be summed to determine compliance with the continuous insulation R-value requirements. Cavity insulation R-values shall not be used to determine compliance with the continuous insulation R-value requirements in Table C402.1.3. Commercial buildings or portions of commercial buildings enclosing Group R occupancies shall use the R-values from the “~~Group R~~” “Group R” column of Table C402.1.3. Commercial buildings or portions of commercial buildings enclosing occupancies other than Group R shall use the ~~*R*-values~~ R-values from the “All other” column of Table C402.1.3.

Proposal # 5250

CE60-19 Part I

CE60-19 Part II

IECC: R202 (IRC N1101.6), R402.1.3 (IRC N1102.1.3)

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

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.

Revise as follows:

R402.1.3 (IRC N1102.1.3) *R*-value computation. ~~Insulation material used in layers, such as framing cavity insulation or continuous insulation, Cavity insulation alone shall be used to determine compliance with the cavity insulation *R*-value requirements in Table R402.1.2. Where cavity insulation is installed in multiple layers, the *R*-values of the cavity insulation layers shall be summed to compute the corresponding component *R*-value.~~ Insulation material used in layers, such as framing cavity insulation or continuous insulation, Cavity insulation alone shall be used to determine compliance with the cavity insulation *R*-value requirements in Table R402.1.2. Where cavity insulation is installed in multiple layers, the *R*-values of the cavity insulation layers shall be summed to determine compliance with the cavity insulation *R*-value requirements. The manufacturer's settled *R*-value shall be used for blown-in insulation. Continuous insulation alone shall be used to determine compliance with the continuous insulation (ci) *R*-value requirements in Table R402.1.2. Where continuous insulation is installed in multiple layers, the *R*-values of the continuous insulation layers shall be summed to determine compliance with the continuous insulation *R*-value requirements. Cavity insulation *R*-values shall not be used to determine compliance with the continuous insulation *R*-value requirements in Table R402.1.2. 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.

Reason: This proposal coordinates with proposed revisions to the IECC-C regarding appropriate consideration of multiple layers of insulation within a given insulation component and also clarifies that different insulation components (e.g., cavity insulation & continuous insulation) *R*-values cannot be summed because the mathematical result will not result in equivalent thermal performance due to cavity insulation components being interrupted by framing and continuous insulation not interrupted by framing.

Cost Impact: The code change proposal will not increase or decrease the cost of construction. As this proposal is consistent with the intent of the code, there should be no affects on the cost of construction.

Proposal # 5248

CE60-19 Part II

CE61-19

IECC: TABLE C402.1.3, TABLE C402.1.4

Proponent: William Fay, Energy-Efficient Codes Coalition, representing Energy-Efficient Codes Coalition (bfay@ase.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 C402.1.3
OPAQUE THERMAL ENVELOPE INSULATION COMPONENT MINIMUM REQUIREMENTS, R-VALUE
METHOD^{a, i}

CLIMATE ZONE	1		2		3		4 EXCEPT MARINE		5 AND MARINE 4		6		
	All other	Group R	All other	Group R	All other	Group R	All other	Group R	All other	Group R	All other	Group R	All other
Roofs													
Insulation entirely above roof deck	R-20ci	R-25ci	R-25ci	R-25ci	R-25ci	R-25ci	R-30ci	R-30ci	R-30ci	R-30ci	R-30ci	R-30ci	R-35ci
Metal buildings ^b	R-19 + R-11 LS	R-19 + R-11 LS	R-19 + R-11 LS	R-19 + R-11 LS	R-19 + R-11 LS	R-19 + R-11 LS	R-19 + R-11 LS	R-19 + R-11 LS	R-19 + R-11 LS	R-19 + R-11 LS	R-25 + R-11 LS	R-25 + R-11 LS R-30 + R-11 LS	R-30 R-11 LS
Attic and other	R-38	R-38	R-38	R-38	R-38	R-38	R-38 R-49	R-38 R-49	R-38 R-49	R-49	R-49	R-49	R-49 R-60
Walls, above grade													
Mass ^g	R-5.7ci ^c	R-5.7ci ^c	R-5.7ci ^c	R-7.6ci	R-7.6ci	R-9.5ci	R-9.5ci	R-11.4ci	R-11.4ci	R-13.3ci	R-13.3ci	R-15.2ci	R-15.2ci
Metal building	R-13+ R-6.5ci	R-13 + R-6.5ci	R-13 + R-6.5ci	R-13 + R-13ci	R-13 + R-6.5ci	R-13ci	R-13 + R-13ci	R-13 + R-13ci	R-13 + R-13ci	R-13 + R-13ci	R-13 + R-13ci	R-13 + R-13ci	R-13 R-13ci
Metal framed	R-13 + R-5ci	R-13 + R-5ci	R-13 + R-5ci	R-13 + R-7.5ci	R-13 + R-7.5ci	R-7.5ci	R-13 + R-7.5ci	R-13 + R-7.5ci	R-13 + R-7.5ci	R-13 + R-7.5ci	R-13 + R-7.5ci	R-13 + R-7.5ci	R-13 R-7.5ci

Wood framed and other	R-13 + R-3.8ci or R-20	R-13 + R-3.8ci or R-20	R-13 + R-3.8ci or R-20	R-13 + R-3.8ci or R-20	R-13 + R-3.8ci or R-20	R-13 + R-3.8ci or R-20	R-13 + R-3.8ci or R-20	R-13 + R-3.8ci or R-20	R-13 + R-3.8ci or R-20	R-13 + R-7.5ci or R-20 + R-3.8ci	R-13 + R-7.5ci or R-20 + R-3.8ci	R-13 + R-7.5ci or R-20 + R-3.8ci	R-13 or R-20 + R-3.8
Walls, below grade													
Below-grade wall ^d	NR	NR	NR	NR	NR	NR	R-7.5ci	R-7.5ci	R-7.5ci	R-7.5ci	R-7.5ci	R-7.5ci	R-10ci
Floors													
Mass ^e	NR	NR	R-6.3ci	R-8.3ci	R-10ci	R-10ci	R-10ci	R-10.4ci	R-10ci	R-12.5ci	R-12.5ci	R-12.5ci	R-15ci
Joist/framing	NR	NR	R-30	R-30	R-30	R-30	R-30	R-30	R-30	R-30	R-30	R-30 ^f	R-30
Slab-on-grade floors													
Unheated slabs	NR	NR	NR	NR	NR	NR	R-10 for 24" below	R-10 for 24" below	R-10 for 24" below	R-10 for 24" below	R-10 for 24" below	R-15 for 24" below	R-15 for 24" below
Heated slabs ^h	R-7.5 for 12" below+ R-5 full slab	R-7.5 for 12" below+ R-5 full slab	R-7.5 for 12" below+ R-5 full slab	R-7.5 for 12" below+ R-5 full slab	R-10 for 24" below+ R-5 full slab	R-10 for 24" below+ R-5 full slab	R-15 for 24" below+ R-5 full slab	R-15 for 24" below+ R-5 full slab	R-15 for 36" below+ R-5 full slab	R-15 for 36" below+ R-5 full slab	R-15 for 36" below+ R-5 full slab	R-20 for 48" below+ R-5 full slab	R-20 for 48" below+ R-5 full slab
Opaque doors													
Nonswinging	R-4.75	R-4.75	R-4.75	R-4.75	R-4.75	R-4.75	R-4.75	R-4.75	R-4.75	R-4.75	R-4.75	R-4.75	R-4.75

For SI: 1 inch = 25.4 mm, 1 pound per square foot = 4.88 kg/m², 1 pound per cubic foot = 16 kg/m³.

ci = Continuous insulation, NR = No Requirement, LS = Liner System.

- Assembly descriptions can be found in ANSI/ASHRAE/IESNA Appendix A.
- Where using *R*-value compliance method, a thermal spacer block shall be provided, otherwise use the *U*-factor compliance method in Table C402.1.4.
- R-5.7ci is allowed to be substituted with concrete block walls complying with ASTM C90, ungrouted or partially grouted at 32 inches or less on center vertically and 48 inches or less on center horizontally, with ungrouted cores filled with materials having a maximum thermal conductivity of 0.44 Btu-in/h·ft² °F.
- Where heated slabs are below grade, below-grade walls shall comply with the exterior insulation requirements for heated slabs.
- "Mass floors" shall be in accordance with Section C402.2.3.
- Steel floor joist systems shall be insulated to R-38.
- "Mass walls" shall be in accordance with Section C402.2.2.
- The first value is for perimeter insulation and the second value is for slab insulation. Perimeter insulation is not required to extend below the bottom of the slab.
- Not applicable to garage doors. See Table C402.1.4.

TABLE C402.1.4
OPAQUE THERMAL ENVELOPE ASSEMBLY MAXIMUM REQUIREMENTS, *U*-FACTOR METHOD^{a, b}

CLIMATE ZONE	1		2		3		4 EXCEPT MARINE		5 AND MARINE 4		6		7	
	All other	Group R	All other	Group R	All other	Group R	All other	Group R	All other	Group R	All other	Group R	All other	Group R
Roofs														
Insulation entirely above roof deck	U-0.048	U-0.039	U-0.039	U-0.039	U-0.039	U-0.039	U-0.032	U-0.032	U-0.032	U-0.032	U-0.032	U-0.032	U-0.028	U-0.028
Metal buildings	U-0.044 U-0.035	U-0.035	U-0.035	U-0.035	U-0.035	U-0.035	U-0.035	U-0.035	U-0.035	U-0.035	U-0.031	U-0.031 U-0.029	U-0.029	U-0.029
Attic and other	U-0.027	U-0.027	U-0.027	U-0.027	U-0.027	U-0.027	U-0.027 U-0.021	U-0.027 U-0.021	U-0.027 U-0.021	U-0.021	U-0.021	U-0.021	U-0.021 U-0.017	U-0.021 U-0.017
Walls, above grade														
Mass ^g	U-0.151	U-0.151	U-0.151	U-0.123	U-0.123	U-0.104	U-0.104	U-0.090	U-0.090	U-0.080	U-0.080	U-0.071	U-0.071	U-0.071
Metal building	U-0.079	U-0.079	U-0.079	U-0.079	U-0.079	U-0.052	U-0.052	U-0.052	U-0.052	U-0.052	U-0.052	U-0.052	U-0.052	U-0.039
Metal framed	U-0.077	U-0.077	U-0.077	U-0.064	U-0.064	U-0.064	U-0.064	U-0.064	U-0.064	U-0.064	U-0.064	U-0.064	U-0.064	U-0.052
Wood framed and other ^c	U-0.064	U-0.064	U-0.064	U-0.064	U-0.064	U-0.064	U-0.064	U-0.064	U-0.064	U-0.064	U-0.051	U-0.051	U-0.051	U-0.051
Walls, below grade														
Below-grade wall ^c	C-1.140 ^e	C-1.140 ^e	C-1.140 ^e	C-1.140 ^e	C-1.140 ^e	C-1.140 ^e	C-0.119	C-0.119	C-0.119	C-0.119	C-0.119	C-0.119	C-0.092	C-0.092
Floors														
Mass ^d	U-0.322 ^e	U-0.322 ^e	U-0.107	U-0.087	U-0.076	U-0.076	U-0.076	U-0.074	U-0.074	U-0.064	U-0.064	U-0.064	U-0.055	U-0.051
Joist/framing	U-0.066 ^e	U-0.066 ^e	U-0.033	U-0.033	U-0.033	U-0.033	U-0.033	U-0.033	U-0.033	U-0.033	U-0.033	U-0.033	U-0.033	U-0.033
Slab-on-grade floors														
Unheated slabs	F-0.73 ^e	F-0.73 ^e	F-0.73 ^e	F-0.73 ^e	F-0.73 ^e	F-0.73 ^e	F-0.54	F-0.54	F-0.54	F-0.54	F-0.54	F-0.52	F-0.40	F-0.40
Heated slabs ^f	F-1.02 0.74	F-1.02 0.74	F-1.02 0.74	F-1.02 0.74	F-0.90 0.74	F-0.90 0.74	F-0.86 0.64	F-0.86 0.64	F-0.79 0.64	F-0.79 0.64	F-0.79 0.55	F-0.69 0.55	F-0.69 0.55	F-0.69 0.55
Opaque doors														

Swinging door	U-0.61	U-0.61	U-0.61	U-0.61	U-0.61	U-0.61	U-0.61	U-0.61	U-0.37	U-0.37	U-0.37	U-0.37	U-0.37
Garage door <14% glazing	U-0.31	U-0.31	U-0.31	U-0.31	U-0.31	U-0.31	U-0.31	U-0.31	U-0.31	U-0.31	U-0.31	U-0.31	U-0.31

For SI: 1 pound per square foot = 4.88 kg/m², 1 pound per cubic foot = 16 kg/m³.

ci = Continuous insulation, NR = No Requirement, LS = Liner System.

- a. Where assembly *U*-factors, *C*-factors, and *F*-factors are established in ANSI/ASHRAE/IESNA 90.1 Appendix A, such opaque assemblies shall be a compliance alternative where those values meet the criteria of this table, and provided that the construction, excluding the cladding system on walls, complies with the appropriate construction details from ANSI/ASHRAE/ISNEA 90.1 Appendix A.
- b. Where *U*-factors have been established by testing in accordance with ASTM C1363, such opaque assemblies shall be a compliance alternative where those values meet the criteria of this table. The *R*-value of continuous insulation shall be permitted to be added to or subtracted from the original tested design.
- c. Where heated slabs are below grade, below-grade walls shall comply with the *U*-factor requirements for above-grade mass walls.
- d. "Mass floors" shall be in accordance with Section C402.2.3.
- e. These *C*-, *F*- and *U*-factors are based on assemblies that are not required to contain insulation.
- f. The first value is for perimeter insulation and the second value is for full slab insulation.
- g. "Mass walls" shall be in accordance with Section C402.2.2.

Reason: The purpose of this code change proposal is to reduce energy costs for commercial building owners and improve long-term energy efficiency by adopting the more efficient and cost-effective opaque envelope requirements from ASHRAE Standard 90.1-2016 or the IECC for roofs. The building envelope typically remains the same for many years after construction and it is particularly important to capture as much cost-effective energy efficiency as possible at construction. After all, the intent of the IECC (C101.3) is to "regulate the design and construction of buildings for the effective use and conservation of energy over the useful life of each building."

The commercial opaque envelope requirements of the IECC have not been comprehensively improved since the 2012 edition, even though ASHRAE has continued to make cost-effective improvements during that same period. This proposal leverages ASHRAE's thorough energy savings and cost-effectiveness analyses to make improvements to the opaque envelope table where ASHRAE improves upon the IECC requirement, but without rolling back the IECC requirements where they meet or exceed the ASHRAE requirement.

We applied a consistent set of actions to each of the values in this table:

- Where ASHRAE Standard 90.1-2016 has a more efficient *U*-factor for an assembly, we propose adopting the ASHRAE *U*-factor.
- Where an improved *U*-factor is adopted, we incorporate an equivalent *R*-value based on Normative Appendix A of ASHRAE Standard 90.1-2016.

The resulting table provides moderate improvements in energy efficiency based on an established model energy code and corrects inconsistencies and errors in the current IECC prescriptive tables.

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

The improved U-factors and R-values in Tables C402.1.3 and C402.1.4 will typically require the addition of more insulation or other efficiency improvements in the IECC's performance-based compliance paths. However, each U-factor selected by ASHRAE for Standard 90.1 has gone through a rigorous energy-savings and cost-effectiveness analysis and consensus vetting from affected interests, so even in cases where construction costs are increased, the improvements will be achievable and cost-effective over the useful life of the product.

Proposal # 4216

CE61-19

CE62-19 Part I

PART I — IECC: TABLE C402.1.3, TABLE C402.1.4, C402.2.2, C402.2.2.1 (New)

PART II — IECC: R402.2.5 (IRC N1102.2.5)

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

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

2018 International Energy Conservation Code

Revise as follows:

TABLE C402.1.3
OPAQUE THERMAL ENVELOPE INSULATION COMPONENT MINIMUM REQUIREMENTS, R-VALUE
METHOD^{a, i}

Portions of table not shown remain unchanged.

Walls, above grade																
Mass ^g	R-5.7ci ^c	R-5.7ci ^c	R-5.7ci ^c	R-7.6ci	R-7.6ci	R-9.5ci	R-9.5ci	R-11.4ci	R-11.4ci	R-13.3ci	R-13.3ci	R-15.2ci	R-15.2ci	R-15.2ci	R-25ci	R-25ci
Metal building	R-13+ R-6.5ci	R-13+ + R-6.5ci	R-13+ + R-6.5ci	R-13+ R-13ci	R-13+ R-6.5ci	R-13+ R-13ci	R-13+ R-13ci	R-13+ + R-13ci	R-13+ + R-13ci	R-13+ + R-13ci	R-13+ + R-13ci	R-13+ + R-13ci	R-13+ + R-13ci	R-13+ + R-13ci	R-13+ + R-13ci	R-13+ + R-19.5ci
Metal framed	R-13+ R-5ci	R-13+ + R-5ci	R-13+ + R-5ci	R-13+ R-7.5ci	R-13+ R-7.5ci	R-13+ R-7.5ci	R-13+ R-7.5ci	R-13+ + R-7.5ci	R-13+ + R-7.5ci	R-13+ + R-7.5ci	R-13+ + R-7.5ci	R-13+ + R-7.5ci	R-13+ + R-7.5ci	R-13+ + R-7.5ci	R-13+ + R-7.5ci	R-13+ + R-17.5ci
Wood framed and other	R-13+ R-3.8ci or R-20	R-13+ + R-3.8ci or R-20	R-13+ + R-3.8ci or R-20	R-13+ R-3.8ci or R-20	R-13+ R-3.8ci or R-20	R-13+ R-3.8ci or R-20	R-13+ R-3.8ci or R-20	R-13+ + R-3.8ci or R-20	R-13+ + R-3.8ci or R-20	R-13+ + R-7.5ci or R-20 + R-3.8ci	R-13+ + R-7.5ci or R-20 + R-3.8ci	R-13+ + R-7.5ci or R-20 + R-3.8ci	R-13+ + R-7.5ci or R-20 + R-3.8ci	R-13+ + R-7.5ci or R-20 + R-3.8ci	R-13+ + R-15.6ci or R-20 + R-10ci	R-13+ + R-15.6ci or R-20 + R-10ci

For SI: 1 inch = 25.4 mm, 1 pound per square foot = 4.88 kg/m², 1 pound per cubic foot = 16 kg/m³.

ci = Continuous insulation, NR = No Requirement, LS = Liner System.

- Assembly descriptions can be found in ANSI/ASHRAE/IESNA Appendix A.
- Where using *R*-value compliance method, a thermal spacer block shall be provided, otherwise use the *U*-factor compliance method in Table C402.1.4.
- R-5.7ci is allowed to be substituted with concrete block walls complying with ASTM C90, ungrouted or partially grouted at 32 inches or less on center vertically and 48 inches or less on center horizontally, with ungrouted cores filled with materials having a maximum thermal

conductivity of 0.44 Btu-in/h- f^2 °F.

- d. Where heated slabs are below grade, below-grade walls shall comply with the exterior insulation requirements for heated slabs.
- e. "Mass floors" shall be in accordance with Section C402.2.3.
- f. Steel floor joist systems shall be insulated to R-38.
- g. "Mass walls" shall be in accordance with ~~Section~~ Sections C402.2.2 and C402.2.2.1.
- h. The first value is for perimeter insulation and the second value is for slab insulation. Perimeter insulation is not required to extend below the bottom of the slab.
- i. Not applicable to garage doors. See Table C402.1.4.

TABLE C402.1.4

OPAQUE THERMAL ENVELOPE ASSEMBLY MAXIMUM REQUIREMENTS, *U*-FACTOR METHOD^{a, b}

Portions of table not shown remain unchanged.

Walls, above grade																
Mass ^g	U- 0.151	U- 0.151	U- 0.151	U- 0.123	U- 0.123	U- 0.104	U- 0.104	U- 0.090	U- 0.090	U- 0.080	U- 0.080	U- 0.071	U- 0.071	U- 0.071	U- 0.061	U- 0.061
Metal building	U- 0.079	U- 0.079	U- 0.079	U- 0.079	U- 0.079	U- 0.052	U- 0.052	U- 0.052	U- 0.052	U- 0.052	U- 0.052	U- 0.052	U- 0.052	U- 0.039	U- 0.052	U- 0.039
Metal framed	U- 0.077	U- 0.077	U- 0.077	U- 0.064	U- 0.064	U- 0.064	U- 0.064	U- 0.064	U- 0.064	U- 0.064	U- 0.064	U- 0.064	U- 0.064	U- 0.052	U- 0.064	U- 0.045
Wood framed and other ^c	U- 0.064	U- 0.064	U- 0.064	U- 0.064	U- 0.064	U- 0.064	U- 0.064	U- 0.064	U- 0.064	U- 0.064	U- 0.051	U- 0.051	U- 0.051	U- 0.051	U- 0.036	U- 0.036

For SI: 1 pound per square foot = 4.88 kg/m², 1 pound per cubic foot = 16 kg/m³.

ci = Continuous insulation, NR = No Requirement, LS = Liner System.

- a. Where assembly *U*-factors, *C*-factors, and *F*-factors are established in ANSI/ASHRAE/IESNA 90.1 Appendix A, such opaque assemblies shall be a compliance alternative where those values meet the criteria of this table, and provided that the construction, excluding the cladding system on walls, complies with the appropriate construction details from ANSI/ASHRAE/ISNEA 90.1 Appendix A.
- b. Where *U*-factors have been established by testing in accordance with ASTM C1363, such opaque assemblies shall be a compliance alternative where those values meet the criteria of this table. The *R*-value of continuous insulation shall be permitted to be added to or subtracted from the original tested design.
- c. Where heated slabs are below grade, below-grade walls shall comply with the *U*-factor requirements for above-grade mass walls.
- d. "Mass floors" shall be in accordance with Section C402.2.3.
- e. These *C*-, *F*- and *U*-factors are based on assemblies that are not required to contain insulation.
- f. The first value is for perimeter insulation and the second value is for full slab insulation.
- g. "Mass walls" shall be in accordance with ~~Section~~ Sections C402.2.2 and C402.2.2.1.

C402.2.2 Above-grade walls. The minimum thermal resistance (*R*-value) of materials installed in the wall cavity between framing members and continuously on the walls shall be as specified in Table C402.1.3, based on framing type and construction materials used in the wall assembly. The *R*-value of integral insulation

installed in concrete masonry units shall not be used in determining compliance with Table C402.1.3 except as otherwise noted in the table. In determining compliance with Table C402.1.4, the use of the *U*-factor of concrete masonry units with integral insulation shall be permitted.

~~"Mass walls" where used as a component in the thermal envelope of a building shall comply with one of the following:~~

- ~~1. Weigh not less than 35 pounds per square foot (171 kg/m^2) of wall surface area.~~
- ~~2. Weigh not less than 25 pounds per square foot (122 kg/m^2) of wall surface area where the material weight is not more than 120 pcf (1900 kg/m^3).~~
- ~~3. Have a heat capacity exceeding $7 \text{ Btu/ft}^2 \cdot ^\circ\text{F}$ ($144 \text{ kJ/m}^2 \cdot \text{K}$).~~
- ~~4. Have a heat capacity exceeding $5 \text{ Btu/ft}^2 \cdot ^\circ\text{F}$ ($103 \text{ kJ/m}^2 \cdot \text{K}$), where the material weight is not more than 120 pcf (1900 kg/m^3).~~

Add new text as follows:

C402.2.2.1 Mass walls. "Mass walls" where used as a component in the thermal envelope of a building shall comply with one of the following:

1. Weigh not less than 35 pounds per square foot (171 kg/m^2) of wall surface area.
2. Weigh not less than 25 pounds per square foot (122 kg/m^2) of wall surface area where the material weight is not more than 120 pcf (1900 kg/m^3).
3. Have a heat capacity exceeding $7 \text{ Btu/ft}^2 \cdot ^\circ\text{F}$ ($144 \text{ kJ/m}^2 \cdot \text{K}$).
4. Have a heat capacity exceeding $5 \text{ Btu/ft}^2 \cdot ^\circ\text{F}$ ($103 \text{ kJ/m}^2 \cdot \text{K}$), where the material weight is not more than 120 pcf (1900 kg/m^3).

Wall elements to the exterior of a vented air space shall be excluded when evaluating the mass wall thermal envelope criteria of this section.

Proposal # 5242

CE62-19 Part I

CE62-19 Part II

IECC: R402.2.5 (IRC N1102.2.5)

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

2018 International Energy Conservation Code

Revise as follows:

R402.2.5 (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, or solid logs but not anchored brick veneer, anchored stone or masonry veneer.
2. Any wall having a heat capacity greater than or equal to 6 Btu/ft² ● °F (123 kJ/m² ● K) except components to the exterior of a vented air space shall be excluded from the heat capacity determination.

Reason: In Item 1, anchored brick veneer, anchored stone, and anchored masonry veneer are required by IRC Section R703.8 and Table R703.8.4(1) to be installed with an airspace of between 1" and 4 ½". The components of a wall to the exterior of a non-sealed (vented) air space required to provide drainage are disconnected thermally from the rest of the thermal envelope of the structure. Accordingly, components of walls to the exterior of a vented air space should not be considered a component of the building thermal envelope. This situation was recognized in Item 1 with the original text of "but not brick veneer". This proposal, for clarity, moves "but not brick veneer" to the end of the sentence and includes *anchored stone* and *masonry veneer* which performs thermally similar to brick veneer. Also, "anchored" is inserted in two locations to appropriately differentiate anchored veneer with the required airspace from adhered masonry veneer addressed in IRC Section R703.12.

Proposed revisions in Item 2 exclude components of the wall to the exterior of a vented air space from the heat capacity calculation because these components are disconnected thermally from the rest of the thermal envelope of the structure.

This proposal is consistent with requirements for mass walls in IECC-C Section C402.2.2 which is similarly clarified in a separate proposal. These changes are needed to clearly recognize that the "mass" of a mass wall must be an integral part of the wall (not thermally disconnected by a vented air space) as was the basis for determining thermal inertia (thermal mass) effects and associated R-value requirements for mass wall assemblies.

Cost Impact: The code change proposal will not increase or decrease the cost of construction. The revisions in Item 1 should not raise the cost of construction because the proposed revisions are consistent with the intent of Item 1. In Item 2, if exterior wall components to the exterior of a vented air space have been considered mass walls in conflict with the intent of Item 1, there could be a cost increase.

Proposal # 5229

CE62-19 Part II

CE63-19

IECC: TABLE C402.1.3, TABLE C402.1.4

Proponent: William Fay, Energy-Efficient Codes Coalition, representing Energy-Efficient Codes Coalition (bfay@ase.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 C402.1.3
OPAQUE THERMAL ENVELOPE INSULATION COMPONENT MINIMUM REQUIREMENTS, R-VALUE
METHOD^{a, i}

CLIMATE ZONE	1		2		3		4 EXCEPT MARINE		5 AND MARINE 4		6		
	All other	Group R	All other	Group R	All other	Group R	All other	Group R	All other	Group R	All other	Group R	All other
Roofs													
Insulation entirely above roof deck	R-20ci	R-25ci	R-25ci	R-25ci	R-25ci	R-25ci	R-30ci	R-30ci	R-30ci	R-30ci	R-30ci	R-30ci	R-35ci
Metal buildings ^b	R-19 + R-11 LS	R-19 + R-11 LS	R-19 + R-11 LS	R-19 + R-11 LS	R-19 + R-11 LS	R-19 + R-11 LS	R-19 + R-11 LS	R-19 + R-11 LS	R-19 + R-11 LS	R-19 + R-11 LS	R-25 + R-11 LS	R-25 + R-11 LS	R-30 + R-11 LS
Attic and other	R-38	R-38	R-38	R-38	R-38	R-38	R-38	R-38	R-38	R-49	R-49	R-49	R-49
Walls, above grade													
Mass ^g	R-5.7ci ^c	R-5.7ci ^c	R-5.7ci ^c	R-7.6ci	R-7.6ci	R-9.5ci	R-9.5ci	R-11.4ci	R-11.4ci	R-13.3ci	R-13.3ci	R-15.2ci	R-15.2ci
Metal building	R-13 + R-6.5ci	R-13 + R-6.5ci	R-13 + R-6.5ci	R-13 + R-13ci	R-13 + R-6.5ci	R-13 + R-13ci	R-13 + R-13ci	R-13 + R-13ci R-13 + R-13ci	R-13 + R-13ci R-13 + R-13ci	R-13 + R-13ci R-13 + R-13ci	R-13 + R-13ci R-13 + R-13ci	R-13 + R-13ci R-13 + R-13ci	R-13 + R-13ci R-13 + R-13ci
Metal framed	R-13 + R-5ci	R-13 + R-5ci	R-13 + R-5ci	R-13 + R-7.5ci	R-13 + R-7.5ci	R-13 + R-7.5ci	R-13 + R-7.5ci	R-13 + R-7.5ci	R-13 + R-7.5ci R-13 + R-10ci	R-13 + R-7.5ci R-13 + R-10ci	R-13 + R-7.5ci R-13 + R-12.5ci	R-13 + R-7.5ci R-13 + R-12.5ci	R-13 + R-7.5ci R-13 + R-12.5ci

Wood framed and other	R-13 + R-3.8ci or R-20	R-13 + R-3.8ci or R-20	R-13 + R-3.8ci or R-20	R-13 + R-3.8ci or R-20	R-13 + R-3.8ci or R-20	R-13 + R-3.8ci or R-20	R-13 + R-3.8ci or R-20	R-13 + R-3.8ci or R-20	R-13 + R-3.8ci or R-20	R-13 + R-3.8ci or R-20	R-13 + R-7.5ci or R-20 + R-3.8ci	R-13 + R-7.5ci or R-20 + R-3.8ci	R-13 + R-7.5ci or R-20 + R-3.8ci	R-13 + R-7.5ci or R-20 + R-3.8ci
Walls, below grade														
Below-grade wall ^d	NR	NR	NR	NR	NR	NR	R-7.5ci	R-7.5ci	R-7.5ci	R-7.5ci	R-7.5ci	R-7.5ci	R-7.5ci	R-10ci
Floors														
Mass ^e	NR	NR	R-6.3ci	R-8.3ci	R-10ci	R-10ci	R-10ci	R-10.4ci	R-10ci	R-12.5ci	R-12.5ci	R-12.5ci	R-12.5ci	R-15ci
Joist/framing	NR	NR	R-30	R-30	R-30	R-30	R-30	R-30	R-30	R-30	R-30	R-30	R-30 ^f	R-30
Slab-on-grade floors														
Unheated slabs	NR	NR	NR	NR	NR	NR	R-10 for 24" below	R-10 for 24" below	R-10 for 24" below	R-10 for 24" below	R-10 for 24" below	R-10 for 24" below	R-15 for 24" below	R-15 for 24" below
Heated slabs ^h	R-7.5 for 12" below+ R-5 full slab	R-7.5 for 12" below+ R-5 full slab	R-7.5 for 12" below+ R-5 full slab	R-7.5 for 12" below+ R-5 full slab	R-10 for 24" below+ R-5 full slab	R-10 for 24" below+ R-5 full slab	R-15 for 24" below+ R-5 full slab	R-15 for 24" below+ R-5 full slab	R-15 for 36" below+ R-5 full slab	R-15 for 36" below+ R-5 full slab	R-15 for 36" below+ R-5 full slab	R-15 for 36" below+ R-5 full slab	R-20 for 48" below+ R-5 full slab	R-20 for 48" below+ R-5 full slab
Opaque doors														
Nonswinging	R-4.75	R-4.75	R-4.75	R-4.75	R-4.75	R-4.75	R-4.75	R-4.75	R-4.75	R-4.75	R-4.75	R-4.75	R-4.75	R-4.75

For SI: 1 inch = 25.4 mm, 1 pound per square foot = 4.88 kg/m², 1 pound per cubic foot = 16 kg/m³.

ci = Continuous insulation, NR = No Requirement, LS = Liner System.

- Assembly descriptions can be found in ANSI/ASHRAE/IESNA Appendix A.
- Where using *R*-value compliance method, a thermal spacer block shall be provided, otherwise use the *U*-factor compliance method in Table C402.1.4.C402.1.4.
- R-5.7ci is allowed to be substituted with concrete block walls complying with ASTM C90, ungrouted or partially grouted at 32 inches or less on center vertically and 48 inches or less on center horizontally, with ungrouted cores filled with materials having a maximum thermal conductivity of 0.44 Btu-in/h-*f*² °F.
- Where heated slabs are below grade, below-grade walls shall comply with the exterior insulation requirements for heated slabs.
- "Mass floors" shall be in accordance with Section C402.2.3.
- Steel floor joist systems shall be insulated to R-38.
- "Mass walls" shall be in accordance with Section C402.2.2.
- The first value is for perimeter insulation and the second value is for slab insulation. Perimeter insulation is not required to extend below the bottom of the slab.

- i. Not applicable to garage doors. See Table C402.1.4. ~~C402.1.4.~~

TABLE C402.1.4
OPAQUE THERMAL ENVELOPE ASSEMBLY MAXIMUM REQUIREMENTS, U-FACTOR METHOD^{a, b}

CLIMATE ZONE	1		2		3		4 EXCEPT MARINE		5 AND MARINE 4		6		7	
	All other	Group R	All other	Group R	All other	Group R	All other	Group R	All other	Group R	All other	Group R	All other	Group R
Roofs														
Insulation entirely above roof deck	U-0.048	U-0.039	U-0.039	U-0.039	U-0.039	U-0.039	U-0.032	U-0.032	U-0.032	U-0.032	U-0.032	U-0.032	U-0.028	U-0.028
Metal buildings	U-0.044	U-0.035	U-0.035	U-0.035	U-0.035	U-0.035	U-0.035	U-0.035	U-0.035	U-0.035	U-0.031	U-0.031	U-0.029	U-0.029
Attic and other	U-0.027	U-0.027	U-0.027	U-0.027	U-0.027	U-0.027	U-0.027	U-0.027	U-0.027	U-0.021	U-0.021	U-0.021	U-0.021	U-0.021
Walls, above grade														
Mass ^g	U-0.151	U-0.151	U-0.151	U-0.123	U-0.123	U-0.104	U-0.104	U-0.090	U-0.090	U-0.080	U-0.080	U-0.071	U-0.071	U-0.071
Metal building	U-0.079	U-0.079	U-0.079	U-0.079	U-0.079	U-0.052	U-0.052	U-0.052	U-0.052	U-0.052	U-0.052	U-0.052	U-0.052	U-0.039
								<u>U-0.050</u>	<u>U-0.050</u>	<u>U-0.050</u>	<u>U-0.050</u>	<u>U-0.050</u>	<u>U-0.044</u>	
Metal framed	U-0.077	U-0.077	U-0.077	U-0.064	U-0.064	U-0.064	U-0.064	U-0.064	U-0.064	U-0.064	U-0.064	U-0.064	U-0.064	U-0.052
								<u>U-0.055</u>	<u>U-0.055</u>	<u>U-0.049</u>	<u>U-0.049</u>	<u>U-0.049</u>	<u>U-0.049</u>	<u>U-0.042</u>
Wood framed and other ^c	U-0.064	U-0.064	U-0.064	U-0.064	U-0.064	U-0.064	U-0.064	U-0.064	U-0.064	U-0.064	U-0.051	U-0.051	U-0.051	U-0.051
								<u>U-0.051</u>	<u>U-0.051</u>					
Walls, below grade														
Below-grade wall ^c	C-1.140 ^e	C-1.140 ^e	C-1.140 ^e	C-1.140 ^e	C-1.140 ^e	C-1.140 ^e	C-0.119	C-0.119	C-0.119	C-0.119	C-0.119	C-0.119	C-0.092	C-0.092
Floors														

Mass ^d	U-0.322 ^e	U-0.322 ^e	U-0.107	U-0.087	U-0.076	U-0.076	U-0.076	U-0.074	U-0.074	U-0.064	U-0.064	U-0.064	U-0.055	U-0.051
Joist/framing	U-0.066 ^e	U-0.066 ^e	U-0.033	U-0.033	U-0.033	U-0.033	U-0.033	U-0.033	U-0.033	U-0.033	U-0.033	U-0.033	U-0.033	U-0.033
Slab-on-grade floors														
Unheated slabs	F-0.73 ^e	F-0.73 ^e	F-0.73 ^e	F-0.73 ^e	F-0.73 ^e	F-0.73 ^e	F-0.54	F-0.54	F-0.54	F-0.54	F-0.54	F-0.52	F-0.40	F-0.40
Heated slabs ^f	F-1.02 0.74	F-1.02 0.74	F-1.02 0.74	F-1.02 0.74	F-0.90 0.74	F-0.90 0.74	F-0.86 0.64	F-0.86 0.64	F-0.79 0.64	F-0.79 0.64	F-0.79 0.55	F-0.69 0.55	F-0.69 0.55	F-0.69 0.55
Opaque doors														
Swinging door	U-0.61	U-0.61	U-0.61	U-0.61	U-0.61	U-0.61	U-0.61	U-0.61	U-0.37	U-0.37	U-0.37	U-0.37	U-0.37	U-0.37
Garage door <14% glazing	U-0.31	U-0.31	U-0.31	U-0.31	U-0.31	U-0.31	U-0.31	U-0.31	U-0.31	U-0.31	U-0.31	U-0.31	U-0.31	U-0.31

For SI: 1 pound per square foot = 4.88 kg/m², 1 pound per cubic foot = 16 kg/m³.

ci = Continuous insulation, NR = No Requirement, LS = Liner System.

- Where assembly *U*-factors, *C*-factors, and *F*-factors are established in ANSI/ASHRAE/IESNA 90.1 Appendix A, such opaque assemblies shall be a compliance alternative where those values meet the criteria of this table, and provided that the construction, excluding the cladding system on walls, complies with the appropriate construction details from ANSI/ASHRAE/ISNEA 90.1 Appendix A.
- Where *U*-factors have been established by testing in accordance with ASTM C1363, such opaque assemblies shall be a compliance alternative where those values meet the criteria of this table. The *R*-value of continuous insulation shall be permitted to be added to or subtracted from the original tested design.
- Where heated slabs are below grade, below-grade walls shall comply with the *U*-factor requirements for above-grade mass walls.
- "Mass floors" shall be in accordance with Section C402.2.3.
- These *C*-, *F*- and *U*-factors are based on assemblies that are not required to contain insulation.
- The first value is for perimeter insulation and the second value is for full slab insulation.
- "Mass walls" shall be in accordance with Section C402.2.2.

Reason: The purpose of this code change proposal is to reduce energy costs for commercial building owners and improve long-term energy efficiency by adopting the more efficient and cost-effective opaque envelope requirements from either ASHRAE Standard 90.1-2016 or the IECC for above-grade walls. The building envelope typically remains the same for many years after construction and it is particularly important to capture as much cost-effective energy efficiency as possible at construction. After all, the intent of the IECC (C101.3) is to "regulate the design and construction of buildings for the effective use and conservation of energy over the useful life of each building."

The commercial opaque envelope requirements of the IECC have not been comprehensively improved since the 2012 edition, even though ASHRAE has continued to make cost-effective improvements during that same period. This proposal leverages ASHRAE's thorough energy savings and cost-effectiveness analyses to make improvements to the opaque envelope table where ASHRAE improves upon the IECC requirement, but without rolling back the IECC requirements where they meet or exceed the ASHRAE requirement.

We applied a consistent set of actions to each of the values in this table:

- Where we discovered clear errors or inconsistencies between the U-factor and R-value table, we corrected them.
- Where ASHRAE Standard 90.1-2016 has a more efficient U-factor for an assembly, we propose adopting the ASHRAE U-factor.
- Where an improved U-factor is adopted, we incorporate an equivalent R-value based on Normative Appendix A of ASHRAE Standard 90.1-2016.

The resulting table provides moderate improvements in energy efficiency based on an established model energy code and corrects inconsistencies and errors in the current IECC prescriptive tables.

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

The improved U-factors and R-values in Tables C402.1.3 and C402.1.4 will typically require the addition of more insulation or other efficiency improvements in the IECC's performance-based compliance paths. However, each U-factor selected by ASHRAE for Standard 90.1 has gone through a rigorous energy-savings and cost-effectiveness analysis and consensus vetting from affected interests, so even in cases where construction costs are increased, the improvements will be achievable and cost-effective over the useful life of the product.

Proposal # 4213

CE63-19

CE64-19

IECC: TABLE C402.1.3, TABLE C402.1.4

Proponent: William Fay, Energy-Efficient Codes Coalition, representing Energy-Efficient Codes Coalition (bfay@ase.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 C402.1.3
OPAQUE THERMAL ENVELOPE INSULATION COMPONENT MINIMUM REQUIREMENTS, R-VALUE
METHOD^{a, i}

CLIMATE ZONE	1		2		3		4 EXCEPT MARINE CLIMATE ZONE 4	
	All other	Group R	All other	Group R	All other	Group R	All other	Group R
Roofs								
Insulation entirely above roof deck	R-20ci	R-25ci	R-25ci	R-25ci	R-25ci	R-25ci	R-30ci	R-30ci
Metal buildings ^b	R-19 + R-11 LS	R-19 + R-11 LS	R-19 + R-11 LS	R-19 + R-11 LS	R-19 + R-11 LS	R-19 + R-11 LS	R-19 + R-11 LS	R-19 + R-11 LS
Attic and other	R-38	R-38	R-38	R-38	R-38	R-38	R-38	R-38
Walls, above grade								
Mass ^g	R-5.7ci ^c	R-5.7ci ^c	R-5.7ci ^c	R-7.6ci	R-7.6ci	R-9.5ci	R-9.5ci	R-11ci
Metal building	R-13 + R-6.5ci	R-13 + R-6.5ci	R-13 + R-6.5ci	R-13 + R-13ci	R-13 + R-6.5ci	R-13 + R-13ci	R-13 + R-13ci	R-13 + R-13ci
Metal framed	R-13 + R-5ci	R-13 + R-5ci	R-13 + R-5ci	R-13 + R-7.5ci	R-13 + R-7.5ci	R-13 + R-7.5ci	R-13 + R-7.5ci	R-13 + R-7.5ci
Wood framed and other	R-13 + R-3.8ci or R-20	R-13 + R-3.8ci or R-20	R-13 + R-3.8ci or R-20	R-13 + R-3.8ci or R-20	R-13 + R-3.8ci or R-20	R-13 + R-3.8ci or R-20	R-13 + R-3.8ci or R-20	R-13 + R-3.8ci or R-20
Walls, below grade								
Below-grade wall ^d	NR	NR	NR	NR	NR	NR	R-7.5ci	R-7.5ci
Floors								
Mass ^e	NR	NR	R-6.3ci	R-8.3ci	R-10ci	R-10ci	R-10ci	R-10ci
Joist/framing	NR	NR	R-30	R-30	R-30	R-30	R-30	R-30
Slab-on-ground								
Unheated slabs	NR	NR	NR	NR	NR	NR	R-10 for 24" below	R-10 for 24" below

Heated slabs ^h	R-7.5 for 12" below+ R-5 full slab	R-7.5 for 12" below+ R-5 full slab	R-7.5 for 12" below+ R-5 full slab	R-7.5 for 12" below+ R-5 full slab	R-10 for 24" below+ R-5 full slab	R-10 for 24" below+ R-5 full slab	R-15 for 24" below+ R-5 full slab	R-15 f below full :
Opaque								
Nonswinging	R-4.75	R-4.75	R-4.75	R-4.75	R-4.75	R-4.75	R-4.75	R-4

For SI: 1 inch = 25.4 mm, 1 pound per square foot = 4.88 kg/m², 1 pound per cubic foot = 16 kg/m³.

ci = Continuous insulation, NR = No Requirement, LS = Liner System.

- Assembly descriptions can be found in ANSI/ASHRAE/IESNA Appendix A.
- Where using *R*-value compliance method, a thermal spacer block shall be provided, otherwise use the *U*-factor compliance method in Table ~~C402.1.4~~ C402.1.4.
- R-5.7ci is allowed to be substituted with concrete block walls complying with ASTM C90, ungrouted or partially grouted at 32 inches or less on center vertically and 48 inches or less on center horizontally, with ungrouted cores filled with materials having a maximum thermal conductivity of 0.44 Btu-in/h-*f*² °F.
- Where heated slabs are below grade, below-grade walls shall comply with the exterior insulation requirements for heated slabs.
- "Mass floors" shall be in accordance with Section C402.2.3.
- Steel floor joist systems shall be insulated to R-38.
- "Mass walls" shall be in accordance with Section C402.2.2.
- The first value is for perimeter insulation and the second value is for slab insulation. Perimeter insulation is not required to extend below the bottom of the slab.
- Not applicable to garage doors. See Table ~~C402.1.4~~ C402.1.4.

TABLE C402.1.4
OPAQUE THERMAL ENVELOPE ASSEMBLY MAXIMUM REQUIREMENTS, *U*-FACTOR METHOD^{a, b}

CLIMATE ZONE	1		2		3		4 EXCEPT MARINE		5 AND MARINE 4		6		7	
	All other	Group R	All other	Group R	All other	Group R	All other	Group R	All other	Group R	All other	Group R	All other	Group R
Roofs														
Insulation entirely above roof deck	U-0.048	U-0.039	U-0.039	U-0.039	U-0.039	U-0.039	U-0.032	U-0.032	U-0.032	U-0.032	U-0.032	U-0.032	U-0.028	U-0.028
Metal buildings	U-0.044	U-0.035	U-0.035	U-0.035	U-0.035	U-0.035	U-0.035	U-0.035	U-0.035	U-0.035	U-0.031	U-0.031	U-0.029	U-0.029
Attic and other	U-0.027	U-0.027	U-0.027	U-0.027	U-0.027	U-0.027	U-0.027	U-0.027	U-0.027	U-0.021	U-0.021	U-0.021	U-0.021	U-0.021
Walls, above grade														
Mass ^g	U-0.151	U-0.151	U-0.151	U-0.123	U-0.123	U-0.104	U-0.104	U-0.090	U-0.090	U-0.080	U-0.080	U-0.071	U-0.071	U-0.071
Metal building	U-0.079	U-0.079	U-0.079	U-0.079	U-0.079	U-0.052	U-0.052	U-0.052	U-0.052	U-0.052	U-0.052	U-0.052	U-0.052	U-0.039

Metal framed	U-0.077	U-0.077	U-0.077	U-0.064	U-0.064	U-0.064	U-0.064	U-0.064	U-0.064	U-0.064	U-0.064	U-0.064	U-0.064	U-0.052
Wood framed and other ^c	U-0.064	U-0.064	U-0.064	U-0.064	U-0.064	U-0.064	U-0.064	U-0.064	U-0.064	U-0.064	U-0.051	U-0.051	U-0.051	U-0.051
Walls, below grade														
Below-grade wall ^c	C-1.140 ^e	C-1.140 ^e	C-1.140 ^e	C-1.140 ^e	C-1.140 ^e	C-1.140 ^e	C-1.140 ^e	C-0.119	C-0.119	C-0.119	C-0.119	C-0.119	C-0.092	C-0.092
								C-0.092	C-0.092	C-0.092	C-0.092	C-0.063	C-0.063	C-0.063
Floors														
Mass ^d	U-0.322 ^e	U-0.322 ^e	U-0.107	U-0.087	U-0.076	U-0.076	U-0.076	U-0.074	U-0.074	U-0.064	U-0.064	U-0.064	U-0.055	U-0.051
Joist/framing	U-0.066 ^e	U-0.066 ^e	U-0.033	U-0.033	U-0.033	U-0.033	U-0.033	U-0.033	U-0.033	U-0.033	U-0.033	U-0.033	U-0.033	U-0.033
Slab-on-grade floors														
Unheated slabs	F-0.73 ^e	F-0.73 ^e	F-0.73 ^e	F-0.73 ^e	F-0.73 ^e	F-0.73 ^e	F-0.54	F-0.54	F-0.54	F-0.54	F-0.54	F-0.52	F-0.40	F-0.40
Heated slabs ^f	F-1.02 0.74	F-1.02 0.74	F-1.02 0.74	F-1.02 0.74	F-0.90 0.74	F-0.90 0.74	F-0.86 0.64	F-0.86 0.64	F-0.79 0.64	F-0.79 0.64	F-0.79 0.55	F-0.69 0.55	F-0.69 0.55	F-0.69 0.55
Opaque doors														
Swinging door	U-0.61	U-0.61	U-0.61	U-0.61	U-0.61	U-0.61	U-0.61	U-0.61	U-0.37	U-0.37	U-0.37	U-0.37	U-0.37	U-0.37
Garage door <14% glazing	U-0.31	U-0.31	U-0.31	U-0.31	U-0.31	U-0.31	U-0.31	U-0.31	U-0.31	U-0.31	U-0.31	U-0.31	U-0.31	U-0.31

For SI: 1 pound per square foot = 4.88 kg/m², 1 pound per cubic foot = 16 kg/m³.

ci = Continuous insulation, NR = No Requirement, LS = Liner System.

- Where assembly *U*-factors, *C*-factors, and *F*-factors are established in ANSI/ASHRAE/IESNA 90.1 Appendix A, such opaque assemblies shall be a compliance alternative where those values meet the criteria of this table, and provided that the construction, excluding the cladding system on walls, complies with the appropriate construction details from ANSI/ASHRAE/IESNA 90.1 Appendix A.
- Where *U*-factors have been established by testing in accordance with ASTM C1363, such opaque assemblies shall be a compliance alternative where those values meet the criteria of this table. The *R*-value of continuous insulation shall be permitted to be added to or subtracted from the original tested design.
- Where heated slabs are below grade, below-grade walls shall comply with the *U*-factor requirements for above-grade mass walls.
- "Mass floors" shall be in accordance with Section C402.2.3.
- These *C*-, *F*- and *U*-factors are based on assemblies that are not required to contain insulation.
- The first value is for perimeter insulation and the second value is for full slab insulation.

- g. “Mass walls” shall be in accordance with Section C402.2.2.

Reason: The purpose of this code change proposal is to reduce energy costs for commercial building owners and improve long-term energy efficiency by adopting the more efficient and cost-effective opaque envelope requirements from ASHRAE Standard 90.1-2016 or the IECC for below-grade walls. The building envelope typically remains the same for many years after construction and it is particularly important to capture as much cost-effective energy efficiency as possible at construction. After all, the intent of the IECC (C101.3) is to “regulate the design and construction of buildings for the effective use and conservation of energy over the useful life of each building.”

The commercial opaque envelope requirements of the IECC have not been comprehensively improved since the 2012 edition, even though ASHRAE has continued to make cost-effective improvements during that same period. This proposal leverages ASHRAE’s thorough energy savings and cost-effectiveness analyses to make improvements to the opaque envelope table where ASHRAE improves upon the IECC requirement, but without rolling back the IECC requirements where they meet or exceed the ASHRAE requirement.

We applied a consistent set of actions to each of the values in this table:

- Where ASHRAE Standard 90.1-2016 has a more efficient U-factor for an assembly, we propose adopting the ASHRAE U-factor.
- Where an improved U-factor is adopted, we incorporate an equivalent R-value based on Normative Appendix A of ASHRAE Standard 90.1-2016.

The resulting table provides moderate improvements in energy efficiency based on an established model energy code and corrects inconsistencies and errors in the current IECC prescriptive tables.

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

The improved U-factors and R-values in Tables C402.1.3 and C402.1.4 will typically require the addition of more insulation or other efficiency improvements in the IECC’s performance-based compliance paths. However, each U-factor selected by ASHRAE for Standard 90.1 has gone through a rigorous energy-savings and cost-effectiveness analysis and consensus vetting from affected interests, so even in cases where construction costs are increased, the improvements will be achievable and cost-effective over the useful life of the product.

Proposal # 4217

CE64-19

CE65-19

IECC: TABLE C402.1.3

Proponent: Daniel Bresette, representing Alliance to Save Energy (dbresette@ase.org); Maureen Guttman, representing BCAP-IBTS (mguttpgh@aol.com)

2018 International Energy Conservation Code

Revise as follows:

TABLE C402.1.3
OPAQUE THERMAL ENVELOPE INSULATION COMPONENT MINIMUM REQUIREMENTS, R-VALUE METHOD^{a, i}

Portions of table not shown remain unchanged.

CLIMATE ZONE	1		2		3		4 EXCEPT MARINE		5 AND MARINE 4		6		7		Other
	All other	Group R	All other	Group R	All other	Group R	All other	Group R	All other	Group R	All other	Group R	All other	Group R	
Floors															
Mass ^e	NR	NR	R-6.3ci	R-8.3ci	R-10ci	R-10ci	R-10.4ci	R-10ci	R-12.5ci	R-12.5ci	R-12.5ci	R-15ci	R-16.7ci	R-16.7ci	1
Joist/framing	NR R-13	NR R-13	R-30	R-30	R-30	R-30	R-30	R-30	R-30	R-30	R-30	R-30 ^f	R-30 ^f	R-30 ^f	R

For SI: 1 inch = 25.4 mm, 1 pound per square foot = 4.88 kg/m², 1 pound per cubic foot = 16 kg/m³.

ci = Continuous insulation, NR = No Requirement, LS = Liner System.

- a. Assembly descriptions can be found in ANSI/ASHRAE/IESNA Appendix A.
- b. Where using *R*-value compliance method, a thermal spacer block shall be provided, otherwise use the *U*-factor compliance method in Table C402.1.4.
- c. R-5.7ci is allowed to be substituted with concrete block walls complying with ASTM C90, ungrouted or partially grouted at 32 inches or less on center vertically and 48 inches or less on center horizontally, with ungrouted cores filled with materials having a maximum thermal conductivity of 0.44 Btu-in/h-*f*² °F.
- d. Where heated slabs are below grade, below-grade walls shall comply with the exterior insulation requirements for heated slabs.
- e. "Mass floors" shall be in accordance with Section C402.2.3.
- f. Steel floor joist systems shall be insulated to R-38.
- g. "Mass walls" shall be in accordance with Section C402.2.2.
- h. The first value is for perimeter insulation and the second value is for slab insulation. Perimeter insulation is not required to extend below the bottom of the slab.
- i. Not applicable to garage doors. See Table C402.1.4.

TABLE C402.1.4
OPAQUE THERMAL ENVELOPE ASSEMBLY MAXIMUM REQUIREMENTS, *U*-FACTOR METHOD^{a, b}

Portions of table not shown remain unchanged.

CLIMATE ZONE	1		2		3		4 EXCEPT MARINE		5 AND MARINE 4		6		7		c
	All other	Group R	All other	Group R	All other	Group R	All other	Group R	All other	Group R	All other	Group R	All other	Group R	
Floors															
Mass ^d	U-0.322 ^e	U-0.322 ^e	U-0.107	U-0.087	U-0.076	U-0.076	U-0.076	U-0.074	U-0.074	U-0.064	U-0.064	U-0.064	U-0.055	U-0.051	0
Joist/framing	U-0.066 ^e	U-0.066 ^e	U-0.033	U-0.033	U-0.033	U-0.033	U-0.033	U-0.033	U-0.033	U-0.033	U-0.033	U-0.033	U-0.033	U-0.033	0

For SI: 1 pound per square foot = 4.88 kg/m², 1 pound per cubic foot = 16 kg/m³.

ci = Continuous insulation, NR = No Requirement, LS = Liner System.

- Where assembly *U*-factors, *C*-factors, and *F*-factors are established in ANSI/ASHRAE/IESNA 90.1 Appendix A, such opaque assemblies shall be a compliance alternative where those values meet the criteria of this table, and provided that the construction, excluding the cladding system on walls, complies with the appropriate construction details from ANSI/ASHRAE/ISNEA 90.1 Appendix A.
- Where *U*-factors have been established by testing in accordance with ASTM C1363, such opaque assemblies shall be a compliance alternative where those values meet the criteria of this table. The *R*-value of continuous insulation shall be permitted to be added to or subtracted from the original tested design.
- Where heated slabs are below grade, below-grade walls shall comply with the *U*-factor requirements for above-grade mass walls.
- "Mass floors" shall be in accordance with Section C402.2.3.
- These *C*-, *F*- and *U*-factors are based on assemblies that are not required to contain insulation.
- The first value is for perimeter insulation and the second value is for full slab insulation.
- "Mass walls" shall be in accordance with Section C402.2.2.

Reason: The purpose of this code change proposal is to improve consistency by applying an R-value for joist/framing floors in climate zone 1 in Table C402.1.3 that matches the corresponding U-factor in Table C402.1.4. The U-factor for joist/framing floors in Table C402.1.4 is consistent with a wood-framed floor insulated to R-13, despite the "NR" notation and footnote "e," which indicate no insulation in the assembly. Because other U-factors and R-values for joist/framing floors in Table C402.1.3 are based on wood-framed assemblies, we applied the equivalent R-value requirement for a U-factor of 0.066, which is R-13. This will improve energy efficiency as compared to the current Table C402.1.3, but it will bring consistency to the two prescriptive tables and simplify enforcement.

Cost Impact: The code change proposal will not increase or decrease the cost of construction. We believe the R-value equivalent in Table C402.1.4 is an error in the IECC and should be made consistent with the U-factor Table.

Proposal # 4645

CE65-19

CE66-19

IECC: TABLE C402.1.3, TABLE C402.1.4

Proponent: William Fay, Energy-Efficient Codes Coalition, representing Energy-Efficient Codes Coalition (bfay@ase.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 C402.1.3
OPAQUE THERMAL ENVELOPE INSULATION COMPONENT MINIMUM REQUIREMENTS, R-VALUE
METHOD^{a, i}

Portions of table not shown remain unchanged.

CLIMATE ZONE	1		2		3		4 EXCEPT MARINE		5 AND MARINE 4		6		7	
	All other	Group R	All other	Group R	All other	Group R	All other	Group R	All other	Group R	All other	Group R	All other	Group R
Floors														
Mass ^e	NR	NR	R-6.3ci	R-8.3ci	R-10ci	R-10ci	R-10ci	R-10.4ci	R-10ci	R-12.5ci	R-12.5ci	R-12.5ci	R-15ci	R-16.7ci
							<u>R-14.6ci</u>	<u>R-16.7ci</u>	<u>R-14.6ci</u>	<u>R-16.7ci</u>	<u>R-16.7ci</u>	<u>R-16.7ci</u>	<u>R-20.9ci</u>	<u>R-20.9ci</u>
Joist/framing	<u>NR</u>	<u>NR</u>	R-30	R-30	R-30	R-30	R-30	R-30	R-30	R-30	R-30	R-30 ^f	R-30 ^f	R-30 ^f
	<u>R-13</u>	<u>R-13</u>										<u>R-38</u>	<u>R-38</u>	<u>R-38</u>

For SI: 1 inch = 25.4 mm, 1 pound per square foot = 4.88 kg/m², 1 pound per cubic foot = 16 kg/m³.

ci = Continuous insulation, NR = No Requirement, LS = Liner System.

- Assembly descriptions can be found in ANSI/ASHRAE/IESNA Appendix A.
- Where using *R*-value compliance method, a thermal spacer block shall be provided, otherwise use the *U*-factor compliance method in Table C402.1.4.
- R-5.7ci is allowed to be substituted with concrete block walls complying with ASTM C90, ungrouted or partially grouted at 32 inches or less on center vertically and 48 inches or less on center horizontally, with ungrouted cores filled with materials having a maximum thermal conductivity of 0.44 Btu-in/h-*f*² °F.
- Where heated slabs are below grade, below-grade walls shall comply with the exterior insulation requirements for heated slabs.
- "Mass floors" shall be in accordance with Section C402.2.3.
- ~~Steel floor joist systems shall be insulated to R-38.~~
- "Mass walls" shall be in accordance with Section C402.2.2.
- The first value is for perimeter insulation and the second value is for slab insulation. Perimeter insulation is not required to extend below the bottom of the slab.
- Not applicable to garage doors. See Table C402.1.4.

TABLE C402.1.4

OPAQUE THERMAL ENVELOPE ASSEMBLY MAXIMUM REQUIREMENTS, *U*-FACTOR METHOD^{a, b}

Portions of table not shown remain unchanged.

CLIMATE ZONE	1		2		3		4 EXCEPT MARINE		5 AND MARINE 4		6		7		c
	All other	Group R	All other	Group R	All other	Group R	All other	Group R	All other	Group R	All other	Group R	All other	Group R	
Floors															
Mass ^d	U-0.322 ^e	U-0.322 ^e	U-0.107	U-0.087	U-0.076 <u>U-0.074</u>	U-0.076 <u>U-0.074</u>	U-0.076 <u>U-0.057</u>	U-0.074 <u>U-0.051</u>	U-0.074 <u>U-0.057</u>	U-0.064 <u>U-0.051</u>	U-0.064 <u>U-0.051</u>	U-0.064 <u>U-0.051</u>	U-0.055 <u>U-0.042</u>	U-0.051 <u>U-0.042</u>	0.042
Joist/framing	U-0.066 ^e	U-0.066 ^e	U-0.033	U-0.033	U-0.033	U-0.033	U-0.033	U-0.033	U-0.033	U-0.033	U-0.033 <u>U-0.027</u>	U-0.033 <u>U-0.027</u>	U-0.033 <u>U-0.027</u>	U-0.033 <u>U-0.027</u>	0.027

For SI: 1 pound per square foot = 4.88 kg/m², 1 pound per cubic foot = 16 kg/m³.

ci = Continuous insulation, NR = No Requirement, LS = Liner System.

- Where assembly *U*-factors, *C*-factors, and *F*-factors are established in ANSI/ASHRAE/IESNA 90.1 Appendix A, such opaque assemblies shall be a compliance alternative where those values meet the criteria of this table, and provided that the construction, excluding the cladding system on walls, complies with the appropriate construction details from ANSI/ASHRAE/ISNEA 90.1 Appendix A.
- Where *U*-factors have been established by testing in accordance with ASTM C1363, such opaque assemblies shall be a compliance alternative where those values meet the criteria of this table. The *R*-value of continuous insulation shall be permitted to be added to or subtracted from the original tested design.
- Where heated slabs are below grade, below-grade walls shall comply with the *U*-factor requirements for above-grade mass walls.
- "Mass floors" shall be in accordance with Section C402.2.3.
- These *C*-, *F*- and *U*-factors are based on assemblies that are not required to contain insulation.
- The first value is for perimeter insulation and the second value is for full slab insulation.
- "Mass walls" shall be in accordance with Section C402.2.2.

Reason: The purpose of this code change proposal is to reduce energy costs for commercial building owners and improve long-term energy efficiency by adopting the more efficient and cost-effective opaque envelope requirements from ASHRAE Standard 90.1-2016 or the IECC for floors. Because all framed floor systems will be required to be insulated to R-38, there is no longer a need for footnote "f" in Table C402.1.3. The building envelope typically remains the same for many years after construction and it is particularly important to capture as much cost-effective energy efficiency as possible at construction. After all, the intent of the IECC (C101.3) is to "regulate the design and construction of buildings for the effective use and conservation of energy over the useful life of each building."

The commercial opaque envelope requirements of the IECC have not been comprehensively improved since

the 2012 edition, even though ASHRAE has continued to make cost effective improvements during that same period. This proposal leverages ASHRAE's thorough energy savings and cost-effectiveness analyses to make improvements to the opaque envelope table where ASHRAE improves upon the IECC requirement, but without rolling back the IECC requirements where they meet or exceed the ASHRAE requirement.

We applied a consistent set of actions to each of the values in this table:

- Where we discovered clear errors or inconsistencies between the U-factor and R-value table, we corrected them.
- Where ASHRAE Standard 90.1-2016 has a more efficient U-factor for an assembly, we propose adopting the ASHRAE U-factor.
- Where an improved U-factor is adopted, we incorporate an equivalent R-value based on Normative Appendix A of ASHRAE Standard 90.1-2016.

The resulting table provides moderate improvements in energy efficiency based on an established model energy code and corrects inconsistencies and errors in the current IECC prescriptive tables.

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

The improved U-factors and R-values in Tables C402.1.3 and C402.1.4 will typically require the addition of more insulation or other efficiency improvements in the IECC's performance-based compliance paths. However, each U-factor selected by ASHRAE for Standard 90.1 has gone through a rigorous energy-savings and cost-effectiveness analysis and consensus vetting from affected interests, so even in cases where construction costs are increased, the improvements will be achievable and cost-effective over the useful life of the product.

Proposal # 4644

CE66-19

CE67-19

IECC: TABLE C402.1.3, TABLE C402.1.4

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

2018 International Energy Conservation Code

Revise as follows:

TABLE C402.1.3
OPAQUE THERMAL ENVELOPE INSULATION COMPONENT MINIMUM REQUIREMENTS, R-VALUE METHOD^{a, i}

Portions of table not shown remain unchanged.

CLIMATE ZONE	1		2		3		4 EXCEPT MARINE		5 AND MARINE 4		6		7
	All other	Group R	All other	Group R	All other	Group R	All other	Group R	All other	Group R	All other	Group R	All other
Slab-on-grade floors													
Unheated slabs	NR	NR	NR	NR	NR	NR	R-10 for 24" below	R-10 for 24" below	R-10 for 24" below	R-10 for 24" below	R-10 for 24" below	R-15 for 24" below	R-15 for 24" below
Heated slabs ^h	R-7.5 for 12" below+ R-5 full slab	R-7.5 for 12" below+ R-5 full slab	R-7.5 for 12" below+ R-5 full slab	R-7.5 for 12" below+ R-5 full slab	R-10 for 24" below+ R-5 full slab	R-10 for 24" below+ R-5 full slab	R-15 for 24" below+ R-5 full slab	R-15 for 24" below+ R-5 full slab	R-15 for 36" below+ R-5 full slab	R-15 for 36" below+ R-5 full slab	R-15 for 36" below+ R-5 full slab	R-20 for 48" below+ R-5 full slab	R-20 for 48" below+ R-5 full slab

For SI: 1 inch = 25.4 mm, 1 pound per square foot = 4.88 kg/m², 1 pound per cubic foot = 16 kg/m³.

ci = Continuous insulation, NR = No Requirement, LS = Liner System.

- a. Assembly descriptions can be found in ANSI/ASHRAE/IESNA Appendix A.
- b. Where using *R*-value compliance method, a thermal spacer block shall be provided, otherwise use the *U*-factor compliance method in Table C402.1.4.
- c. R-5.7ci is allowed to be substituted with concrete block walls complying with ASTM C90, ungrouted or partially grouted at 32 inches or less on center vertically and 48 inches or less on center horizontally, with ungrouted cores filled with materials having a maximum thermal conductivity of 0.44 Btu-in/h-*f*² °F.
- d. Where heated slabs are below grade, below-grade walls shall comply with the exterior insulation requirements for heated slabs.
- e. "Mass floors" shall be in accordance with Section C402.2.3.
- f. Steel floor joist systems shall be insulated to R-38.
- g. "Mass walls" shall be in accordance with Section C402.2.2.
- h. The first value is for perimeter insulation and the second value is for full, under-slab insulation. Perimeter insulation is not required to extend below the bottom of the slab.
- i. Not applicable to garage doors. See Table C402.1.4.

TABLE C402.1.4

OPAQUE THERMAL ENVELOPE ASSEMBLY MAXIMUM REQUIREMENTS, *U*-FACTOR METHOD^{a, b}

Portions of table not shown remain unchanged.

CLIMATE ZONE	1		2		3		4 EXCEPT MARINE		5 AND MARINE 4		6		7		
	All other	Group R	All other	Group R	All other	Group R	All other	Group R	All other	Group R	All other	Group R	All other	Group R	All othe
Slab-on-grade floors															
Unheated slabs	F-0.73 ^e	F-0.73 ^e	F-0.73 ^e	F-0.73 ^e	F-0.73 ^e	F-0.73 ^e	F-0.54	F-0.54	F-0.54	F-0.54	F-0.54	F-0.52	F-0.40	F-0.40	F-0.40
Heated slabs ^f	F-1.02 0.74	F-1.02 0.74	F-1.02 0.74	F-1.02 0.74	F-0.90 0.74	F-0.90 0.74	F-0.86 0.64	F-0.86 0.64	F-0.79 0.64	F-0.79 0.64	F-0.79 0.55	F-0.69 0.55	F-0.69 0.55	F-0.69 0.55	F-0.69 0.55

For SI: 1 pound per square foot = 4.88 kg/m², 1 pound per cubic foot = 16 kg/m³.

ci = Continuous insulation, NR = No Requirement, LS = Liner System.

- Where assembly *U*-factors, *C*-factors, and *F*-factors are established in ANSI/ASHRAE/IESNA 90.1 Appendix A, such opaque assemblies shall be a compliance alternative where those values meet the criteria of this table, and provided that the construction, excluding the cladding system on walls, complies with the appropriate construction details from ANSI/ASHRAE/IESNA 90.1 Appendix A.
- Where *U*-factors have been established by testing in accordance with ASTM C1363, such opaque assemblies shall be a compliance alternative where those values meet the criteria of this table. The *R*-value of continuous insulation shall be permitted to be added to or subtracted from the original tested design.
- Where heated slabs are below grade, below-grade walls shall comply with the *U*-factor requirements for above-grade mass walls.
- "Mass floors" shall be in accordance with Section C402.2.3.
- These *C*-, *F*- and *U*-factors are based on assemblies that are not required to contain insulation.
- The first value is for perimeter insulation and the second value is for full, under-slab insulation.
- "Mass walls" shall be in accordance with Section C402.2.2.

Reason: To be clear, it was the intent of the proponent to be specific to "full, under-slab" installations in these instances; Table C402.1.3 and Table C402.1.4.

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. No change to stringency is proposed.

Proposal # 5391

CE67-19

CE68-19

IECC: TABLE C402.1.3, TABLE C402.1.4

Proponent: William Fay, Energy-Efficient Codes Coalition, representing Energy-Efficient Codes Coalition (bfay@ase.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 C402.1.3
OPAQUE THERMAL ENVELOPE INSULATION COMPONENT MINIMUM REQUIREMENTS, R-VALUE
METHOD^{a, i}

CLIMATE ZONE	1		2		3		4 EXCEPT MARINE		5 AND MARINE 4		6		
	All other	Group R	All other	Group R	All other	Group R	All other	Group R	All other	Group R	All other	Group R	All other
Roofs													
Insulation entirely above roof deck	R-20ci	R-25ci	R-25ci	R-25ci	R-25ci	R-25ci	R-30ci	R-30ci	R-30ci	R-30ci	R-30ci	R-30ci	R-35ci
Metal buildings ^b	R-19 + R-11 LS	R-19 + R-11 LS	R-19 + R-11 LS	R-19 + R-11 LS	R-19 + R-11 LS	R-19 + R-11 LS	R-19 + R-11 LS	R-19 + R-11 LS	R-19 + R-11 LS	R-19 + R-11 LS	R-25 + R-11 LS	R-25 + R-11 LS	R-30 + R-11 LS
Attic and other	R-38	R-38	R-38	R-38	R-38	R-38	R-38	R-38	R-38	R-49	R-49	R-49	R-49
Walls, above grade													
Mass ^g	R-5.7ci ^c	R-5.7ci ^c	R-5.7ci ^c	R-7.6ci	R-7.6ci	R-9.5ci	R-9.5ci	R-11.4ci	R-11.4ci	R-13.3ci	R-13.3ci	R-15.2ci	R-15.2ci
Metal building	R-13+ R-6.5ci	R-13+ R-6.5ci	R-13+ R-6.5ci	R-13+ R-13ci	R-13+ R-6.5ci	R-13+ R-13ci	R-13+ R-13ci	R-13+ R-13ci	R-13+ R-13ci	R-13+ R-13ci	R-13+ R-13ci	R-13+ R-13ci	R-13+ R-13ci
Metal framed	R-13+ R-5ci	R-13+ R-5ci	R-13+ R-5ci	R-13+ R-7.5ci	R-13+ R-7.5ci	R-13+ R-7.5ci	R-13+ R-7.5ci	R-13+ R-7.5ci	R-13+ R-7.5ci	R-13+ R-7.5ci	R-13+ R-7.5ci	R-13+ R-7.5ci	R-13+ R-7.5ci
Wood framed and other	R-13+ R-3.8ci or R-20	R-13+ R-3.8ci or R-20	R-13+ R-3.8ci or R-20	R-13+ R-3.8ci or R-20	R-13+ R-3.8ci or R-20	R-13+ R-3.8ci or R-20	R-13+ R-3.8ci or R-20	R-13+ R-3.8ci or R-20	R-13+ R-3.8ci or R-20	R-13+ R-7.5ci or R-20 + R-3.8ci	R-13+ R-7.5ci or R-20 + R-3.8ci	R-13+ R-7.5ci or R-20 + R-3.8ci	R-13+ R-7.5ci or R-20 + R-3.8ci
Walls, below grade													
Below-grade wall ^d	NR	NR	NR	NR	NR	NR	R-7.5ci	R-7.5ci	R-7.5ci	R-7.5ci	R-7.5ci	R-7.5ci	R-10ci

Floors													
Mass ^e	NR	NR	R-6.3ci	R-8.3ci	R-10ci	R-10ci	R-10ci	R-10.4ci	R-10ci	R-12.5ci	R-12.5ci	R-12.5ci	R-15ci
Joist/ framing	NR	NR	R-30	R-30	R-30	R-30	R-30	R-30	R-30	R-30	R-30	R-30 ^f	R-30
Slab-on-grade floors													
Unheated slabs	NR	NR	NR	NR	NR	NR R-10 for 24" below	R-10 for 24" below	R-10 for 24" below	R-10 for 24" below	R-10 for 24" below	R-10 for 24" below	R-15 for 24" below	R-15 for 24" below
Heated slabs ^h	R-7.5 for 12" below+ R-5 full slab	R-7.5 for 12" below+ R-5 full slab	R-7.5 for 12" below+ R-5 full slab	R-7.5 for 12" below+ R-5 full slab	R-10 for 24" below+ R-5 full slab	R-10 for 24" below+ R-5 full slab	R-15 for 24" below+ R-5 full slab	R-15 for 24" below+ R-5 full slab	R-15 for 36" below+ R-5 full slab	R-15 for 36" below+ R-5 full slab	R-15 for 36" below+ R-5 full slab	R-20 for 48" below+ R-5 full slab	R-20 for 48" below+ R-5 full slab
Opaque doors													
Nonswinging	R-4.75	R-4.75	R-4.75	R-4.75	R-4.75	R-4.75	R-4.75	R-4.75	R-4.75	R-4.75	R-4.75	R-4.75	R-4.75

For SI: 1 inch = 25.4 mm, 1 pound per square foot = 4.88 kg/m², 1 pound per cubic foot = 16 kg/m³.

ci = Continuous insulation, NR = No Requirement, LS = Liner System.

- Assembly descriptions can be found in ANSI/ASHRAE/IESNA Appendix A.
- Where using *R*-value compliance method, a thermal spacer block shall be provided, otherwise use the *U*-factor compliance method in Table C402.1.4.
- R-5.7ci is allowed to be substituted with concrete block walls complying with ASTM C90, ungrouted or partially grouted at 32 inches or less on center vertically and 48 inches or less on center horizontally, with ungrouted cores filled with materials having a maximum thermal conductivity of 0.44 Btu-in/h·ft² °F.
- Where heated slabs are below grade, below-grade walls shall comply with the exterior insulation requirements for heated slabs.
- "Mass floors" shall be in accordance with Section C402.2.3.
- Steel floor joist systems shall be insulated to R-38.
- "Mass walls" shall be in accordance with Section C402.2.2.
- The first value is for perimeter insulation and the second value is for slab insulation. Perimeter insulation is not required to extend below the bottom of the slab.
- Not applicable to garage doors. See Table C402.1.4.

TABLE C402.1.4
OPAQUE THERMAL ENVELOPE ASSEMBLY MAXIMUM REQUIREMENTS, *U*-FACTOR METHOD^{a, b}

CLIMATE ZONE	1		2		3		4 EXCEPT MARINE		5 AND MARINE 4		6		7	
	All other	Group R	All other	Group R	All other	Group R	All other	Group R	All other	Group R	All other	Group R	All other	Group R
Roofs														

Insulation entirely above roof deck	U-0.048	U-0.039	U-0.039	U-0.039	U-0.039	U-0.039	U-0.032	U-0.032	U-0.032	U-0.032	U-0.032	U-0.032	U-0.028	U-0.028
Metal buildings	U-0.044	U-0.035	U-0.035	U-0.035	U-0.035	U-0.035	U-0.035	U-0.035	U-0.035	U-0.035	U-0.035	U-0.031	U-0.031	U-0.029
Attic and other	U-0.027	U-0.027	U-0.027	U-0.027	U-0.027	U-0.027	U-0.027	U-0.027	U-0.027	U-0.027	U-0.021	U-0.021	U-0.021	U-0.021
Walls, above grade														
Mass ^g	U-0.151	U-0.151	U-0.151	U-0.123	U-0.123	U-0.104	U-0.104	U-0.090	U-0.090	U-0.080	U-0.080	U-0.071	U-0.071	U-0.071
Metal building	U-0.079	U-0.079	U-0.079	U-0.079	U-0.079	U-0.052	U-0.052	U-0.052	U-0.052	U-0.052	U-0.052	U-0.052	U-0.052	U-0.039
Metal framed	U-0.077	U-0.077	U-0.077	U-0.064	U-0.064	U-0.064	U-0.064	U-0.064	U-0.064	U-0.064	U-0.064	U-0.064	U-0.064	U-0.052
Wood framed and other ^c	U-0.064	U-0.064	U-0.064	U-0.064	U-0.064	U-0.064	U-0.064	U-0.064	U-0.064	U-0.064	U-0.051	U-0.051	U-0.051	U-0.051
Walls, below grade														
Below-grade wall ^c	C-1.140 ^e	C-1.140 ^e	C-1.140 ^e	C-1.140 ^e	C-1.140 ^e	C-1.140 ^e	C-0.119	C-0.119	C-0.119	C-0.119	C-0.119	C-0.119	C-0.092	C-0.092
Floors														
Mass ^d	U-0.322 ^e	U-0.322 ^e	U-0.107	U-0.087	U-0.076	U-0.076	U-0.076	U-0.074	U-0.074	U-0.064	U-0.064	U-0.064	U-0.055	U-0.051
Joist/framing	U-0.066 ^e	U-0.066 ^e	U-0.033	U-0.033	U-0.033	U-0.033	U-0.033	U-0.033	U-0.033	U-0.033	U-0.033	U-0.033	U-0.033	U-0.033
Slab-on-grade floors														
Unheated slabs	F-0.73 ^e	F-0.73 ^e	F-0.73 ^e	F-0.73 ^e	F-0.73 ^e	F-0.73 ^e	F-0.73^e F-0.54	F-0.54 F-0.54	F-0.54 F-0.54	F-0.54 F-0.54	F-0.54 F-0.54	F-0.52 F-0.434	F-0.40	F-0.40
Heated slabs ^f	F-1.02 0.74	F-1.02 0.74	F-1.02 0.74	F-1.02 0.74	F-0.90 0.74	F-0.90 0.74	F-0.86 0.64	F-0.86 0.64	F-0.79 0.64	F-0.79 0.64	F-0.79 0.55	F-0.69 0.55	F-0.69 0.55	F-0.69 0.55
Opaque doors														
Swinging door	U-0.61	U-0.61	U-0.61	U-0.61	U-0.61	U-0.61	U-0.61	U-0.61	U-0.37	U-0.37	U-0.37	U-0.37	U-0.37	U-0.37
Garage door <14% glazing	U-0.31	U-0.31	U-0.31	U-0.31	U-0.31	U-0.31	U-0.31	U-0.31	U-0.31	U-0.31	U-0.31	U-0.31	U-0.31	U-0.31

For SI: 1 pound per square foot = 4.88 kg/m², 1 pound per cubic foot = 16 kg/m³.

ci = Continuous insulation, NR = No Requirement, LS = Liner System.

- a. Where assembly *U*-factors, *C*-factors, and *F*-factors are established in ANSI/ASHRAE/IESNA 90.1 Appendix A, such opaque assemblies shall be a compliance alternative where those values meet the criteria of this table, and provided that the construction, excluding the cladding system on walls, complies with the appropriate construction details from ANSI/ASHRAE/ISNEA 90.1 Appendix A.
- b. Where *U*-factors have been established by testing in accordance with ASTM C1363, such opaque assemblies shall be a compliance alternative where those values meet the criteria of this table. The *R*-value of continuous insulation shall be permitted to be added to or subtracted from the original tested design.
- c. Where heated slabs are below grade, below-grade walls shall comply with the *U*-factor requirements for above-grade mass walls.
- d. "Mass floors" shall be in accordance with Section C402.2.3.
- e. These *C*-, *F*- and *U*-factors are based on assemblies that are not required to contain insulation.
- f. The first value is for perimeter insulation and the second value is for full slab insulation.
- g. "Mass walls" shall be in accordance with Section C402.2.2.

Reason: The purpose of this code change proposal is to reduce energy costs for commercial building owners and improve long-term energy efficiency by adopting the more efficient and cost-effective opaque envelope requirements from ASHRAE Standard 90.1-2016 or the IECC for slab-on-grade floors in climate zones 3-6. The building envelope typically remains the same for many years after construction and it is particularly important to capture as much cost-effective energy efficiency as possible at construction. After all, the intent of the IECC (C101.3) is to "regulate the design and construction of buildings for the effective use and conservation of energy over the useful life of each building."

The commercial opaque envelope requirements of the IECC have not been comprehensively improved since the 2012 edition, even though ASHRAE has continued to make cost-effective improvements during that same period. This proposal leverages ASHRAE's thorough energy savings and cost-effectiveness analyses to make improvements to the opaque envelope table where ASHRAE improves upon the IECC requirement, but without rolling back the IECC requirements where they meet or exceed the ASHRAE requirement.

We applied a consistent set of actions to each of the values in this table:

- Where ASHRAE Standard 90.1-2016 has a more efficient *U*-factor for an assembly, we propose adopting the ASHRAE *U*-factor.
- Where an improved *U*-factor is adopted, we incorporate an equivalent *R*-value based on Normative Appendix A of ASHRAE Standard 90.1-2016.

The resulting table provides moderate improvements in energy efficiency based on an established model energy code and corrects inconsistencies and errors in the current IECC prescriptive tables.

Cost Impact: The code change proposal will increase the cost of construction. The improved *F*-factors and *R*-values in Tables C402.1.3 and C402.1.4 will typically require the addition of more insulation or other efficiency improvements in the IECC's performance-based compliance paths. However, each *U*-factor selected by ASHRAE for Standard 90.1 has gone through a rigorous energy-savings and cost-effectiveness analysis and consensus vetting from affected interests, so even in cases where construction costs are increased, the improvements will be achievable and cost-effective over the useful life of the product.

CE69-19

IECC: TABLE C402.1.3, TABLE C402.1.4

Proponent: William Fay, Energy-Efficient Codes Coalition, representing Energy-Efficient Codes Coalition (bfay@ase.org); Harry Misuriello, representing American Council for an Energy-Efficient Economy (misuriello@verizon.net)

2018 International Energy Conservation Code

Revise as follows:

TABLE C402.1.3
OPAQUE THERMAL ENVELOPE INSULATION COMPONENT MINIMUM REQUIREMENTS, R-VALUE
METHOD^{a, i}

CLIMATE ZONE	1		2		3		4 EXCEPT MARINE		5 AND MARINE 4		6		
	All other	Group R	All other	Group R	All other	Group R	All other	Group R	All other	Group R	All other	Group R	All othe
Roofs													
Insulation entirely above roof deck	R-20ci	R-25ci	R-25ci	R-25ci	R-25ci	R-25ci	R-30ci	R-30ci	R-30ci	R-30ci	R-30ci	R-30ci	R-35ci
Metal buildings ^b	R-19 + R-11 LS	R-19 + R-11 LS	R-19 + R11 LS	R-19 + R-11 LS	R-19 + R-11 LS	R-19 + R-11 LS	R-19 + R-11 LS	R-19 + R-11 LS	R-19 + R-11 LS	R-19 + R-11 LS	R-25 + R-11 LS	R-25 + R-11 LS	R-30 + R-11 LS
Attic and other	R-38	R-38	R-38	R-38	R-38	R-38	R-38	R-38	R-38	R-49	R-49	R-49	R-49
Walls, above grade													
Mass ^g	R-5.7ci ^c	R-5.7ci ^c	R-5.7ci ^c	R-7.6ci	R-7.6ci	R-9.5ci	R-9.5ci	R-11.4ci	R-11.4ci	R-13.3ci	R-13.3ci	R-15.2ci	R-15.2ci
Metal building	R-13+ R-6.5ci	R-13 + R-6.5ci	R13 + R-6.5ci	R-13 + R-13ci	R-13 + R-6.5ci	R-13 + R-13ci	R-13 + R-13ci	R-13 + R-13ci	R-13 + R-13ci	R-13 + R-13ci	R-13 + R-13ci	R-13 + R-13ci	R-13 + R-13ci
Metal framed	R-13 + R-5ci	R-13 + R-5ci	R-13 + R-5ci	R-13 + R-7.5ci	R-13 + R-7.5ci	R-13 + R-7.5ci	R-13 + R-7.5ci	R-13 + R-7.5ci	R-13 + R-7.5ci	R-13 + R-7.5ci	R-13 + R-7.5ci	R-13 + R-7.5ci	R-13 + R-7.5ci
Wood framed and other	R-13 + R-3.8ci or R-20	R-13 + R-3.8ci or R-20	R-13 + R-3.8ci or R-20	R-13 + R-3.8ci or R-20	R-13 + R-3.8ci or R-20	R-13 + R-3.8ci or R-20	R-13 + R-3.8ci or R-20	R-13 + R-3.8ci or R-20	R-13 + R-3.8ci or R-20	R-13 + R-7.5ci or R-20 + R-3.8ci	R-13 + R-7.5ci or R-20 + R-3.8ci	R-13 + R-7.5ci or R-20 + R-3.8ci	R-13 + R-7.5ci or R-20 + R-3.8ci
Walls, below grade													
Below-grade wall ^d	NR	NR	NR	NR	NR	NR	R-7.5ci	R-7.5ci	R-7.5ci	R-7.5ci	R-7.5ci	R-7.5ci	R-10ci

Floors													
Mass ^e	NR	NR	R-6.3ci	R-8.3ci	R-10ci	R-10ci	R-10ci	R-10.4ci	R-10ci	R-12.5ci	R-12.5ci	R-12.5ci	R-15ci
Joist/framing	NR	NR	R-30	R-30	R-30	R-30	R-30	R-30	R-30	R-30	R-30	R-30 ^f	R-30
Slab-on-grade floors													
Unheated slabs	NR	NR	NR	NR	NR	NR	R-10 for 24" below	R-10 for 24" below	R-10 for 24" below	R-10 for 24" below	R-10 for 24" below	R-15 for 24" below	R-15 for 24" below
Heated slabs ^h	R-7.5 for 12" below+ R-5 full slab	R-7.5 for 12" below+ R-5 full slab	R-7.5 for 12" below+ R-5 full slab	R-7.5 for 12" below+ R-5 full slab	R-10 for 24" below+ R-5 full slab	R-10 for 24" below+ R-5 full slab	R-15 for 24" below+ R-5 full slab	R-15 for 24" below+ R-5 full slab	R-15 for 36" below+ R-5 full slab	R-15 for 36" below+ R-5 full slab	R-15 for 36" below+ R-5 full slab	R-20 for 48" below+ R-5 full slab	R-20 for 48" below+ R-5 full slab
Opaque doors													
Nonswinging	R-4.75	R-4.75	R-4.75	R-4.75	R-4.75	R-4.75	R-4.75	R-4.75	R-4.75	R-4.75	R-4.75	R-4.75	R-4.75

For SI: 1 inch = 25.4 mm, 1 pound per square foot = 4.88 kg/m², 1 pound per cubic foot = 16 kg/m³.

ci = Continuous insulation, NR = No Requirement, LS = Liner System.

- Assembly descriptions can be found in ANSI/ASHRAE/IESNA Appendix A.
- Where using *R*-value compliance method, a thermal spacer block shall be provided, otherwise use the *U*-factor compliance method in Table C402.1.4.
- R-5.7ci is allowed to be substituted with concrete block walls complying with ASTM C90, ungrouted or partially grouted at 32 inches or less on center vertically and 48 inches or less on center horizontally, with ungrouted cores filled with materials having a maximum thermal conductivity of 0.44 Btu-in/h-*f*² °F.
- Where heated slabs are below grade, below-grade walls shall comply with the exterior insulation requirements for heated slabs.
- "Mass floors" shall be in accordance with Section C402.2.3.
- Steel floor joist systems shall be insulated to R-38.
- "Mass walls" shall be in accordance with Section C402.2.2.
- The first value is for perimeter insulation and the second value is for slab insulation. Perimeter insulation is not required to extend below the bottom of the slab.
- Not applicable to garage doors. See Table C402.1.4.

TABLE C402.1.4
OPAQUE THERMAL ENVELOPE ASSEMBLY MAXIMUM REQUIREMENTS, *U*-FACTOR METHOD^{a, b}

CLIMATE ZONE	1		2		3		4 EXCEPT MARINE		5 AND MARINE 4		6		7	
	All other	Group R	All other	Group R	All other	Group R	All other	Group R	All other	Group R	All other	Group R	All other	Group R
Roofs														

Insulation entirely above roof deck	U-0.048	U-0.039	U-0.039	U-0.039	U-0.039	U-0.039	U-0.032	U-0.032	U-0.032	U-0.032	U-0.032	U-0.032	U-0.028	U-0.028
Metal buildings	U-0.044	U-0.035	U-0.035	U-0.035	U-0.035	U-0.035	U-0.035	U-0.035	U-0.035	U-0.035	U-0.031	U-0.031	U-0.029	U-0.029
Attic and other	U-0.027	U-0.027	U-0.027	U-0.027	U-0.027	U-0.027	U-0.027	U-0.027	U-0.027	U-0.021	U-0.021	U-0.021	U-0.021	U-0.021
Walls, above grade														
Mass ^g	U-0.151	U-0.151	U-0.151	U-0.123	U-0.123	U-0.104	U-0.104	U-0.090	U-0.090	U-0.080	U-0.080	U-0.071	U-0.071	U-0.071
Metal building	U-0.079	U-0.079	U-0.079	U-0.079	U-0.079	U-0.052	U-0.052	U-0.052	U-0.052	U-0.052	U-0.052	U-0.052	U-0.052	U-0.039
Metal framed	U-0.077	U-0.077	U-0.077	U-0.064	U-0.064	U-0.064	U-0.064	U-0.064	U-0.064	U-0.064	U-0.064	U-0.064	U-0.064	U-0.052
Wood framed and other ^c	U-0.064	U-0.064	U-0.064	U-0.064	U-0.064	U-0.064	U-0.064	U-0.064	U-0.064	U-0.064	U-0.051	U-0.051	U-0.051	U-0.051
Walls, below grade														
Below-grade wall ^c	C-1.140 ^e	C-1.140 ^e	C-1.140 ^e	C-1.140 ^e	C-1.140 ^e	C-1.140 ^e	C-0.119	C-0.119	C-0.119	C-0.119	C-0.119	C-0.119	C-0.092	C-0.092
Floors														
Mass ^d	U-0.322 ^e	U-0.322 ^e	U-0.107	U-0.087	U-0.076	U-0.076	U-0.076	U-0.074	U-0.074	U-0.064	U-0.064	U-0.064	U-0.055	U-0.051
Joist/framing	U-0.066 ^e	U-0.066 ^e	U-0.033	U-0.033	U-0.033	U-0.033	U-0.033	U-0.033	U-0.033	U-0.033	U-0.033	U-0.033	U-0.033	U-0.033
Slab-on-grade floors														
Unheated slabs	F-0.73 ^e	F-0.73 ^e	F-0.73 ^e	F-0.73 ^e	F-0.73 ^e	F-0.73 ^e	F-0.54	F-0.54	F-0.54	F-0.54	F-0.54	F-0.52	F-0.40 <u>F-0.51</u>	F-0.40 <u>F-0.434</u>
Heated slabs ^f	F-1.02 0.74	F-1.02 0.74	F-1.02 0.74	F-1.02 0.74	F-0.90 0.74	F-0.90 0.74	F-0.86 0.64	F-0.86 0.64	F-0.79 0.64	F-0.79 0.64	F-0.79 0.55	F-0.69 0.55	F-0.69 0.55	F-0.69 0.55
Opaque doors														
Swinging door	U-0.61	U-0.61	U-0.61	U-0.61	U-0.61	U-0.61	U-0.61	U-0.61	U-0.37	U-0.37	U-0.37	U-0.37	U-0.37	U-0.37
Garage door <14% glazing	U-0.31	U-0.31	U-0.31	U-0.31	U-0.31	U-0.31	U-0.31	U-0.31	U-0.31	U-0.31	U-0.31	U-0.31	U-0.31	U-0.31

For SI: 1 pound per square foot = 4.88 kg/m², 1 pound per cubic foot = 16 kg/m³.

ci = Continuous insulation, NR = No Requirement, LS = Liner System.

- a. Where assembly *U*-factors, *C*-factors, and *F*-factors are established in ANSI/ASHRAE/IESNA 90.1 Appendix A, such opaque assemblies shall be a compliance alternative where those values meet the criteria of this table, and provided that the construction, excluding the cladding system on walls, complies with the appropriate construction details from ANSI/ASHRAE/ISNEA 90.1 Appendix A.
- b. Where *U*-factors have been established by testing in accordance with ASTM C1363, such opaque assemblies shall be a compliance alternative where those values meet the criteria of this table. The *R*-value of continuous insulation shall be permitted to be added to or subtracted from the original tested design.
- c. Where heated slabs are below grade, below-grade walls shall comply with the *U*-factor requirements for above-grade mass walls.
- d. "Mass floors" shall be in accordance with Section C402.2.3.
- e. These *C*-, *F*- and *U*-factors are based on assemblies that are not required to contain insulation.
- f. The first value is for perimeter insulation and the second value is for full slab insulation.
- g. "Mass walls" shall be in accordance with Section C402.2.2.

Reason: The purpose of this code change proposal is to reduce building energy costs and improve long-term energy efficiency by adopting ASHRAE's more efficient and cost-effective requirements for unheated slab insulation in climate zones 7-8. The current IECC *F*-factors for unheated slabs in these climate zones do not correspond with the *R*-value requirements in Table C402.1.3, nor do they correspond with *F*-factor data for common slab-on-grade floor assemblies per Normative Appendix A of ASHRAE Standard 90.1-2016. We believe the *F*-factors in the IECC are in error, and we propose adopting both ASHRAE's *R*-values and *F*-factors for these climate zones. The result will be improved efficiency and consistency across the IECC's prescriptive tables. The building envelope typically remains the same for many years after construction and it is particularly important to capture as much cost-effective energy efficiency as possible at construction. After all, the intent of the IECC (C101.3) 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 improved *F*-factors and *R*-values in Tables C402.1.3 and C402.1.4 will typically require the addition of more insulation or other efficiency improvements in the IECC's performance-based compliance paths. However, each component value selected by ASHRAE for Standard 90.1 has gone through a rigorous energy-savings and cost-effectiveness analysis and consensus vetting from affected interests, so even in cases where construction costs are increased, the improvements will be achievable and cost-effective over the useful life of the product. This proposal will also correct an error in the IECC Table C402.1.4 and bring consistency between the two prescriptive tables, simplifying compliance and enforcement.

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CE69-19

CE70-19

IECC: TABLE C402.1.3, TABLE C402.1.4, C402.4.5, C402.4.5.1(New), C402.4.5.2(New)

Proponent: Connor Barbaree, representing ASHRAE (cbarbaree@ashrae.org)

2018 International Energy Conservation Code

Revise as follows:

TABLE C402.1.3
OPAQUE THERMAL ENVELOPE INSULATION COMPONENT MINIMUM REQUIREMENTS, R-VALUE METHOD^{a, i}

Portions of table not shown remain unchanged.

CLIMATE ZONE	1		2		3		4 EXCEPT MARINE		5 AND MARINE 4		6		7		8
	All other	Group R	All other	Group R	All other	Group R	All other	Group R	All other	Group R	All other	Group R	All other	Group R	
Opaque doors															
Nonswinging	R-4.75	R-4.75	R-4.75	R-4.75	R-4.75	R-4.75	R-4.75	R-4.75	R-4.75	R-4.75	R-4.75	R-4.75	R-4.75	R-4.75	R-4.75

For SI: 1 inch = 25.4 mm, 1 pound per square foot = 4.88 kg/m², 1 pound per cubic foot = 16 kg/m³.

ci = Continuous insulation, NR = No Requirement, LS = Liner System.

- a. Assembly descriptions can be found in ANSI/ASHRAE/IESNA Appendix A.
- b. Where using *R*-value compliance method, a thermal spacer block shall be provided, otherwise use the *U*-factor compliance method in Table C402.1.4.
- c. R-5.7ci is allowed to be substituted with concrete block walls complying with ASTM C90, ungrouted or partially grouted at 32 inches or less on center vertically and 48 inches or less on center horizontally, with ungrouted cores filled with materials having a maximum thermal conductivity of 0.44 Btu-in/h-ft² °F.
- d. Where heated slabs are below grade, below-grade walls shall comply with the exterior insulation requirements for heated slabs.
- e. "Mass floors" shall be in accordance with Section C402.2.3.
- f. Steel floor joist systems shall be insulated to R-38.
- g. "Mass walls" shall be in accordance with Section C402.2.2.
- h. The first value is for perimeter insulation and the second value is for slab insulation. Perimeter insulation is not required to extend below the bottom of the slab.
- i. Not applicable to garage doors. See Table C402.1.4.

TABLE C402.1.4
OPAQUE THERMAL ENVELOPE ASSEMBLY MAXIMUM REQUIREMENTS, U-FACTOR METHOD^{a, b}

CLIMATE ZONE	1		2		3		4 EXCEPT MARINE		5 AND MARINE 4		6		7	
	All other	Group R	All other	Group R	All other	Group R	All other	Group R	All other	Group R	All other	Group R	All other	Group R

Roofs														
Insulation entirely above roof deck	U-0.048	U-0.039	U-0.039	U-0.039	U-0.039	U-0.039	U-0.032	U-0.032	U-0.032	U-0.032	U-0.032	U-0.032	U-0.028	U-0.028
Metal buildings	U-0.044	U-0.035	U-0.035	U-0.035	U-0.035	U-0.035	U-0.035	U-0.035	U-0.035	U-0.035	U-0.031	U-0.031	U-0.029	U-0.029
Attic and other	U-0.027	U-0.027	U-0.027	U-0.027	U-0.027	U-0.027	U-0.027	U-0.027	U-0.027	U-0.021	U-0.021	U-0.021	U-0.021	U-0.021
Walls, above grade														
Mass ^g	U-0.151	U-0.151	U-0.151	U-0.123	U-0.123	U-0.104	U-0.104	U-0.090	U-0.090	U-0.080	U-0.080	U-0.071	U-0.071	U-0.071
Metal building	U-0.079	U-0.079	U-0.079	U-0.079	U-0.079	U-0.052	U-0.052	U-0.052	U-0.052	U-0.052	U-0.052	U-0.052	U-0.052	U-0.039
Metal framed	U-0.077	U-0.077	U-0.077	U-0.064	U-0.064	U-0.064	U-0.064	U-0.064	U-0.064	U-0.064	U-0.064	U-0.064	U-0.064	U-0.052
Wood framed and other ^c	U-0.064	U-0.064	U-0.064	U-0.064	U-0.064	U-0.064	U-0.064	U-0.064	U-0.064	U-0.064	U-0.051	U-0.051	U-0.051	U-0.051
Walls, below grade														
Below-grade wall ^c	C-1.140 ^e	C-1.140 ^e	C-1.140 ^e	C-1.140 ^e	C-1.140 ^e	C-1.140 ^e	C-0.119	C-0.119	C-0.119	C-0.119	C-0.119	C-0.119	C-0.092	C-0.092
Floors														
Mass ^d	U-0.322 ^e	U-0.322 ^e	U-0.107	U-0.087	U-0.076	U-0.076	U-0.076	U-0.074	U-0.074	U-0.064	U-0.064	U-0.064	U-0.055	U-0.051
Joist/framing	U-0.066 ^e	U-0.066 ^e	U-0.033	U-0.033	U-0.033	U-0.033	U-0.033	U-0.033	U-0.033	U-0.033	U-0.033	U-0.033	U-0.033	U-0.033
Slab-on-grade floors														
Unheated slabs	F-0.73 ^e	F-0.73 ^e	F-0.73 ^e	F-0.73 ^e	F-0.73 ^e	F-0.73 ^e	F-0.54	F-0.54	F-0.54	F-0.54	F-0.54	F-0.52	F-0.40	F-0.40
Heated slabs ^f	F-1.02 0.74	F-1.02 0.74	F-1.02 0.74	F-1.02 0.74	F-0.90 0.74	F-0.90 0.74	F-0.86 0.64	F-0.86 0.64	F-0.79 0.64	F-0.79 0.64	F-0.79 0.55	F-0.69 0.55	F-0.69 0.55	F-0.69 0.55
Opaque doors														
NonSwinging door	U-0.31	U-0.31	U-0.31	U-0.31	U-0.31	U-0.31	U-0.31	U-0.31	U-0.31	U-0.31	U-0.31	U-0.31	U-0.31	U-0.31
Swinging door	U-0.61 U-0.37	U-0.61 U-0.37	U-0.61 U-0.37	U-0.61 U-0.37	U-0.61 U-0.37	U-0.61 U-0.37	U-0.61 U-0.37	U-0.61 U-0.37	U-0.37	U-0.37	U-0.37	U-0.37	U-0.37	U-0.37
Garage door <14% glazing	U-0.31	U-0.31	U-0.31	U-0.31	U-0.31	U-0.31	U-0.31	U-0.31	U-0.31	U-0.31	U-0.31	U-0.31	U-0.31	U-0.31

For SI: 1 pound per square foot = 4.88 kg/m², 1 pound per cubic foot = 16 kg/m³.

ci = Continuous insulation, NR = No Requirement, LS = Liner System.

- a. Where assembly *U*-factors, *C*-factors, and *F*-factors are established in ANSI/ASHRAE/IESNA 90.1 Appendix A, such opaque assemblies shall be a compliance alternative where those values meet the criteria of this table, and provided that the construction, excluding the cladding system on walls, complies with the appropriate construction details from ANSI/ASHRAE/ISNEA 90.1 Appendix A.
- b. Where *U*-factors have been established by testing in accordance with ASTM C1363, such opaque assemblies shall be a compliance alternative where those values meet the criteria of this table. The *R*-value of continuous insulation shall be permitted to be added to or subtracted from the original tested design.
- c. Where heated slabs are below grade, below-grade walls shall comply with the *U*-factor requirements for above-grade mass walls.
- d. "Mass floors" shall be in accordance with Section C402.2.3.
- e. These *C*-, *F*- and *U*-factors are based on assemblies that are not required to contain insulation.
- f. The first value is for perimeter insulation and the second value is for full slab insulation.
- g. "Mass walls" shall be in accordance with Section C402.2.2.
- h. Swinging door U-factors shall be determined in accordance with NFRC-100.

C402.4.5 Doors. Opaque swinging doors shall be considered as part of the gross area of above-grade walls that are part of the building thermal envelope. Opaque doors shall comply with Section C402.4.5.1 or Section C402.5.2.

Add new text as follows:

C402.5.1 Opaque swinging doors Opaque nonswinging doors shall comply with Table C402.1.4.

C402.4.5.2 Nonswinging Doors. Opaque nonswinging doors that are horizontally hinged sectional doors with a single row of fenestration shall have an assembly *U*-factor less than or equal to 0.440 in Climate Zones 0 through 6 and less than or equal to 0.360 in Climate Zones 7 and 8, provided the fenestration area is at least 14 percent and not more than 25 percent of the total door area.

Exception: Other doors shall comply with the provisions of Section C402.4.3 for vertical fenestration.

Reason: Based on cost data gathered from industry partners and thermal performance from ASHRAE research project 1236 the optimal *U*-factor for these doors was determined. The performance of doors is more accurately reflected using *U*-factors. Additionally, the industry is moving towards assembly *U*-factors rather than *R*-values for these products. In the event that other proposals introduce Climate Zone 0 the current values for Climate Zone 1 should be used for Climate Zone 0 as well.

Bibliography: ASHRAE, "Heat Transfer through Roll-Up Doors, Revolving Doors and Opaque Nonresidential Swinging, Sliding and Rolling Doors", ASHRAE International, Atlanta, GA, Research Project 1236, July, 2006. McBride, M., "Development of Economic Scalar Ratios for ASHRAE Standard 90.1 R", ASHRAE, USDOE, ORNL, Building Envelope Conference-Thermal Envelopes VI, Clearwater FL, December, 1991.

Cost Impact: The code change proposal will increase the cost of construction Using national energy costs of \$1.22/therm for natural gas, \$.0939 for electricity, and a 40 year life time, as expressed in the formula $LLC = (U \cdot SR_h \cdot H_{coef} \cdot HDD \cdot P_h) + (U \cdot SR_c \cdot ((C_{coef1} \cdot CDD) + C_{coef2} \cdot P_c))$, the proposed door criteria have the lowest Life Cycle Cost as indicated in the table below. For an explanation of the formula above, see Development of Economic Scalar Ratios for ASHRAE Standard 90.1.

Swinging Doors

ILP Description	Cost ILfactor
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NonSwinging Doors

ILP Description	Cost
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Description	Uvalue	LCC
uninsulated	0.00	0.7000
1 3/8 polyurethane	0.50	0.3700
1 3/4 polyurethane	4.08	0.3400
frame and door	9.17	0.3100

Description	Uvalue
uninsulated	0.00
1 3/8 inch	4.46
2 inch	5.36
3 inch #1	10.27
3 inch #2	20.54

Description	Uvalue	LCC
uninsulated	0.700	50.89
CZ 8 1 3/8 polyurethane	0.370	27.40
1 3/4 polyurethane	0.340	28.80
frame and door	0.310	31.71
Description	Uvalue	LCC
uninsulated	0.700	37.65
CZ 7 1 3/8 polyurethane	0.370	20.40
1 3/4 polyurethane	0.340	22.37
frame and door	0.310	25.84
Description	Uvalue	LCC
uninsulated	0.700	30.74
CZ 6 1 3/8 polyurethane	0.370	16.75
1 3/4 polyurethane	0.340	19.01
frame and door	0.310	22.78
Description	Uvalue	LCC
uninsulated	0.700	24.73
CZ 5 1 3/8 polyurethane	0.370	13.57
1 3/4 polyurethane	0.340	16.09
frame and door	0.310	20.12
Description	Uvalue	LCC
uninsulated	0.700	20.47
CZ 4 1 3/8 polyurethane	0.370	11.32
1 3/4 polyurethane	0.340	14.02
frame and door	0.310	18.24
Description	Uvalue	LCC
uninsulated	0.700	14.21
CZ 3 1 3/8 polyurethane	0.370	8.01
1 3/4 polyurethane	0.340	10.98
frame and door	0.310	15.46
Description	Uvalue	LCC
uninsulated	0.700	11.02
CZ 2 1 3/8 polyurethane	0.370	6.32
1 3/4 polyurethane	0.340	9.43
frame and door	0.310	14.05
Description	Uvalue	LCC
uninsulated	0.700	10.75
CZ 1 1 3/8 polyurethane	0.370	6.18
1 3/4 polyurethane	0.340	9.30
frame and door	0.310	13.93

Description	Uvalue
uninsulated	1.450
1 3/8 inch	0.360
2 inch	0.310
3 inch #1	0.270
3 inch #2	0.240
Description	Uvalue
uninsulated	1.450
1 3/8 inch	0.360
2 inch	0.310
3 inch #1	0.270
3 inch #2	0.240
Description	Uvalue
uninsulated	1.450
1 3/8 inch	0.360
2 inch	0.310
3 inch #1	0.270
3 inch #2	0.240
Description	Uvalue
uninsulated	1.450
1 3/8 inch	0.360
2 inch	0.310
3 inch #1	0.270
3 inch #2	0.240
Description	Uvalue
uninsulated	1.450
1 3/8 inch	0.360
2 inch	0.310
3 inch #1	0.270
3 inch #2	0.240
Description	Uvalue
uninsulated	1.450
1 3/8 inch	0.360
2 inch	0.310
3 inch #1	0.270
3 inch #2	0.240
Description	Uvalue
uninsulated	1.450
1 3/8 inch	0.360
2 inch	0.310
3 inch #1	0.270

Proposal # 4917

CE70-19

CE71-19

IECC: C402.1.4.1 (New), C402.1.4.2 (New), C402.1.4.3 (New), C402.2.1, C402.2.1.1, C402.2.1.1 (New), C402.2.1.2 (New), C402.2.1.3 (New), C402.2.1.4 (New)

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

C402.1.4 Assembly *U*-factor, *C*-factor or *F*-factor-based method. Building thermal envelope opaque assemblies shall meet the requirements of Sections C402.2 and C402.4 based on the climate zone specified in Chapter 3. Building thermal envelope opaque assemblies intended to comply on an assembly *U*-, *C*- or *F*-factor basis shall have a *U*-, *C*- or *F*-factor not greater than that specified in Table C402.1.4. Commercial buildings or portions of commercial buildings enclosing *Group R* occupancies shall use the *U*-, *C*- or *F*-factor from the “*Group R*” column of Table C402.1.4. Commercial buildings or portions of commercial buildings enclosing occupancies other than *Group R* shall use the *U*-, *C*- or *F*-factor from the “All other” column of Table C402.1.4

Add new text as follows:

C402.1.4.1 Roof/Ceiling Assembly. The maximum, roof/ceiling assembly *U*-factor shall not exceed that specified in Table C402.1.4 based on construction materials used in the roof/ceiling assembly.

C402.1.4.1.1 Tapered, above-deck insulation based on thickness. Where used as a component of a maximum roof/ceiling assembly *U*-factor calculation, the sloped roof insulation *R*-value contribution to that calculation shall use either the arithmetic average thickness or the volumetric average thickness in inches (mm) along with the material *R*-value-per-inch (per-mm) solely for *U*-factor compliance as prescribed in Section C402.1.4.

C402.1.4.1.2 Suspended ceilings. Insulation installed on suspended ceilings having removable ceiling tiles shall not be considered part of the minimum thermal resistance (*R*-value) of roof insulation or assembly *U*-factor of the roof/ceiling construction.

C402.1.4.1.3 Joints staggered. Continuous insulation board shall be installed in not less than two layers and the edge joints between each layer of insulation shall be staggered, except where insulation tapers to the roof deck at a gutter edge, roof drain or scupper.

Revise as follows:

C402.2.1 Roof assembly. The minimum thermal resistance (*R*-value) of the insulating material installed either between the roof framing or continuously on the roof assembly shall be as specified in Table C402.1.3, based on construction materials used in the roof assembly. ~~Insulation installed on a suspended ceiling having removable ceiling tiles shall not be considered as part of the minimum thermal resistance of the roof insulation. Continuous insulation board shall be installed in not less than 2 layers and the edge joints between each layer of insulation shall be staggered.~~

Exceptions:

1. ~~Continuously insulated roof assemblies where the thickness of insulation varies 1 inch (25 mm) or less and where the area-weighted *U*-factor is equivalent to the same assembly with the *R*-value specified in Table C402.1.3.~~
2. ~~Where tapered insulation is used with insulation entirely above deck, the *R*-value where the insulation thickness varies 1 inch (25 mm) or less from the minimum thickness of tapered~~

- insulation shall comply with the *R*-value specified in Table C402.1.3.
3. ~~Two layers of insulation are not required where insulation tapers to the roof deck, such as at roof drains.~~

Add new text as follows:

C402.2.1.1 Tapered, above-deck insulation based on thickness. Where used as a component of a maximum roof/ceiling assembly R-value calculation, the sloped roof insulation R-value contribution to that calculation shall use either the arithmetic average thickness or the volumetric average thickness in inches (mm) along with the material R-value-per-inch (per-mm) solely for R-value compliance as prescribed in Section C402.1.4.

C402.2.1.2 Minimum thickness, lowest point. The minimum thickness of tapered, above-deck roof insulation at its lowest point, gutter edge, roof drain or scupper, shall be no less than 1 inch (25 mm).

C402.2.1.3 Suspended ceilings. Insulation installed on suspended ceilings having removable ceiling tiles shall not be considered part of the minimum thermal resistance (R-value) of roof insulation or assembly U-factor of the roof/ceiling construction.

C402.2.1.4 Joints staggered. Continuous insulation board shall be installed in not less than two layers and the edge joints between each layer of insulation shall be staggered, except where insulation tapers to the roof deck at a gutter edge, roof drain or scupper.

Revise as follows:

~~C402.2.1.1~~ **C402.2.1.5 Skylight curbs.** Skylight curbs shall be insulated to the level of roofs with insulation entirely above the deck or R-5, whichever is less.

Exception: Unit skylight curbs included as a component of a skylight listed and labeled in accordance with NFRC 100 shall not be required to be insulated.

Reason: The primary objective of this proposal is to repair and preserve the intent in original change EC31-03/04 (AM PC) by New Buildings Institute which correctly added a “first-ever” use of an R-value equivalent, area-weighted average U-factor option in lieu of an “R-value Only” compliance option. This change also addresses confusing code syntax suggested by NRCA’s own follow-on proposal several cycles later CE115-13 (AS) to provide guidance as to how code users use the first three rows of Table C402.1.4.

The clear intent of the “charging” paragraph to Section C402.2 is to limit the following sub-sections (C402.2.1 Roofs, C402.2.2 Walls, C402.2.3 Floors, etc.) solely to the R-value compliance method by way of Table C402.1.3. Accordingly, this proposal is limited solely to correctly relocating the appropriate U-factor alternative as a New! subsection to C402.1.4 where it belongs; for roof/ceiling installations only. With this proposal, NRCA is leaving it to others to clean the remaining instances throughout C402.2 where R-value compliance and U-factor compliance are mixed and matched.

To begin, NBI’s EC31-03/04 correctly proposed a “first-ever” option to allow the use of R-value equivalent, area-weighted average U-factors in lieu of “R-values only.” At the time the 2003 IECC offered an “R-values only” compliance path. Note, an “Equivalent U-factor” compliance path did not first appear until the 2009 IECC Edition. So then, while EC31-03/04 was innovative in allowing the accepted engineering practice of an area-weighted calculation, it did not provide the level of specificity on which to base or how to perform the calculation. Nonetheless, it should be recognized that EC31-03/04 clearly passed as an endorsement that *approved*, area-weighted average U-factor calculations are to be recognized in the IECC. Notwithstanding such endorsement, EC31-03/04 left many in the industry without a code-enforceable solution.

802.2.4 Roof assembly. The minimum thermal resistance (*R*-value) of the insulating material installed either between the roof framing or continuously on the roof assembly shall be as specified in Table 802.2.(1), based on construction materials used in the roof assembly.

Exception: Continuously insulated roof assemblies where the thickness of insulation varies 1 inch (25.4 mm) or less and where the area weighted U-factor is equivalent to the same assembly with the R-value specified in Table 802.2.2(1).

Sometime later, and well after the 2009 IECC was improved to allow an “Equivalent U-factor” methodology, CE115-13 was proposed by the NRCA. In the reason to CE115-13, the NRCA admitted its members had become confused with regard to NBI’s original intent for the lone exception to Section 802.2.4; but also, that it was the intent of the NRCA to “clarify the use and application of slope-to-drain insulation in roofing projects.” Regrettably, the NRCA suggested solution (i.e., the coexistence of Section 402.2.1, Exceptions 1 and 2 as they read today) did not reflect the historical evidence and eventual evolution of the 2009 IECC thereon to recognize the accepted engineering practice of an area-weighted calculation.

The proposal preserves the independent expressions of 1) minimum thickness, 2) staggered joints, 3) back-loaded, suspended ceilings and 4) skylight curbs along with 5) tapered insulation system designs that are consistent with *The NRCA Roofing Manual for Membrane Roof Systems* written in code-enforceable language. *The NRCA Roofing Manual for Membrane Roof Systems-2019 Ed.*, is a continuation of a long-standing series of publications from the National Roofing Contractors Association (NRCA) intended to provide in-depth, expert and best industry practices concerning the design, materials and installation of quality membrane roof systems.

It is unnecessary to preserve the minimum “skylight curb” provision of C402.2.1.1 as the Assembly U-factor, C-factor or F-factor-based method provides the user with maximum flexibility toward achieving assembly U-factor, C-factor or F-factor-based compliance in accordance with Table C402.1.4 and accepted engineering practices.

For the utility of future users, the following excerpts and figures from *The NRCA Roofing Manual for Membrane Roof Systems-2015 Ed.*, could be used as explanatory commentary:

1. For one- and two-way, sloped roof insulation systems the arithmetic average thickness shall be calculated in accordance with Equation 4-W and as indicated in Figure 4-4. For more complex sloped configurations, the tapered layout shall be broken down into one- and two-way slope regions.

Arithmetic average thickness = $LP + [\frac{1}{2} \times (HP - LP)]$ (Equation 4-W)

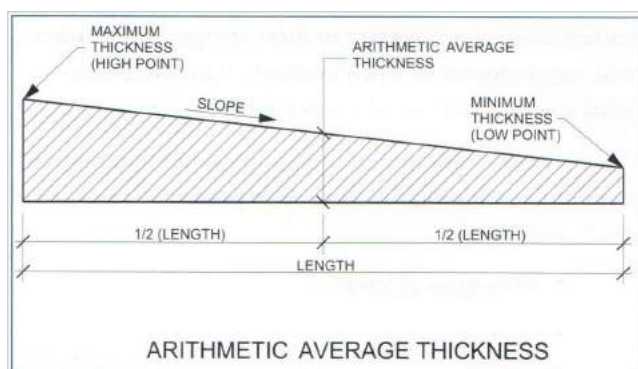


Figure 4-4: Arithmetic average thickness

2. For symmetrical square, four-way sloped roof insulation systems the volumetric average thickness shall be calculated in accordance with Equation 4-X or 4-Y, and as indicated in Equations 4-5 or 4-6, respectively.

Volumetric average thickness = $LP + \left[\frac{2}{3} \times (HP - LP) \right]$ (**Equation 4-X**)

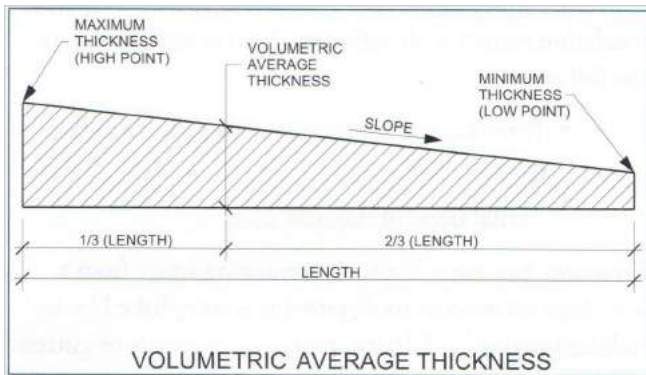


Figure 4-5: Volumetric average thickness

Volumetric average thickness = Volume of insulation / Roof surface area (**Equation 4-Y**)

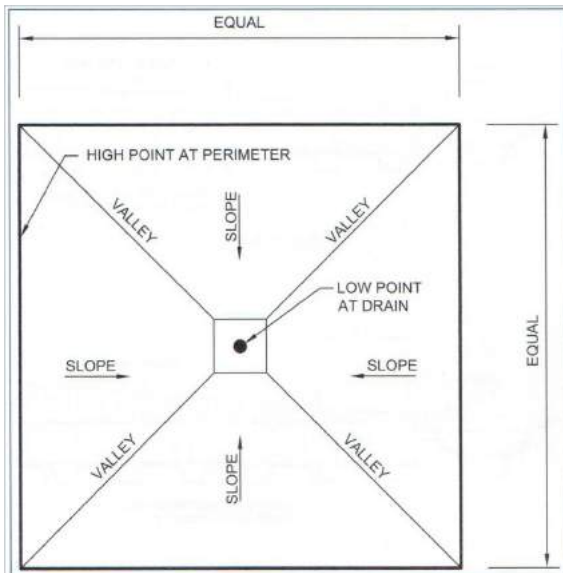


Figure 4-6: Symmetrical four-way slope

3. For all other sloped roof insulation systems, the volumetric average thickness shall be calculated in accordance with Equation 4-Z and as indicated in Figure 4-7.

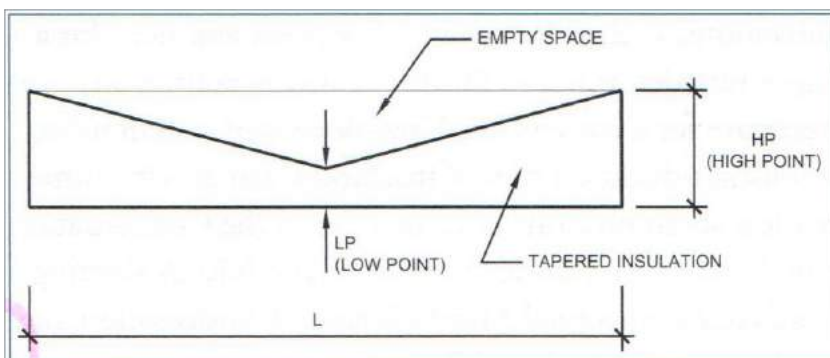


Figure 4-7: Volumetric average thickness, second method

Volumetric average thickness = (Volume of insulation – Volume anticipated waste) / Roof surface area

(Equation 4-Z)

where:

LP = Lowest point, or insulation system minimum thickness.

HP = Highest point, or insulation system maximum thickness.

L = Length, one side of square roof surface area.

Volume of solid insulation = $HP \times L^2$

Volume of empty space = $\frac{1}{3} \times L \times (HP - LP)$

Volume of insulation = $(HP \times L^2) - \frac{1}{3} \times L \times (HP - LP)$

The proposal is product neutral and inclusive of all rigid board insulation types including, cellular glass, expanded and extruded polystyrene, faced and fiber-reinforced gypsum board, stone wool, perlite board, polyisocyanurate, high-density polyisocyanurate, wood fiber board and composite board.

Bibliography: *NRCA Roofing Manual for Membrane Roof Systems* - 2019 Ed., National Roofing Contractors Association, 10255 W. Higgins Road, suite 600, rosemont, IL 60018-5607.

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, as the provisions of **C402.1.4, Assembly U-factor, C-factor or F-factor-based methodolog[ies]**, remain a design option addressing constructability issues in new construction and *reroofing* projects even without the change, and where a newly proposed or existing roof deck does not provide adequate slope for positive drainage.

Proposal # 5313

CE71-19

CE72-19

IECC: C402.1.4.1 (New), C402.1.4.2 (New), C402.1.4.3 (New), C402.2.1

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:

C402.1.4 Assembly *U*-factor, *C*-factor or *F*-factor-based method. Building thermal envelope opaque assemblies shall meet the requirements of Sections C402.2 and C402.4 based on the climate zone specified in Chapter 3. Building thermal envelope opaque assemblies intended to comply on an assembly *U*-, *C*- or *F*-factor basis shall have a *U*-, *C*- or *F*-factor not greater than that specified in Table C402.1.4. Commercial buildings or portions of commercial buildings enclosing *Group R* occupancies shall use the *U*-, *C*- or *F*-factor from the “*Group R*” column of Table C402.1.4. Commercial buildings or portions of commercial buildings enclosing occupancies other than *Group R* shall use the *U*-, *C*- or *F*-factor from the “All other” column of Table C402.1.4

Add new text as follows:

C402.1.4.1 Tapered, above-deck insulation based on thickness. Continuously insulated roof assemblies where the thickness of insulation varies 1 inch (25 mm) or more and where the area-weighted *U*-factor is equivalent to the same assembly with the *U*-factor specified in Table C402.1.4.

C402.1.4.2 Suspended ceilings Insulation installed on suspended ceilings having removable ceiling tiles shall not be considered part of the minimum thermal resistance (*R*-value) of roof insulation or assembly *U*-factor of the roof/ceiling construction.

C402.1.4.3 Joints staggered Continuous insulation board shall be installed in not less than two (2) layers and the edge joints between each layer of insulation shall be staggered, except where insulation tapers to the roof deck at a gutter edge, roof drain or scupper.

Revise as follows:

C402.2.1 Roof assembly. The minimum thermal resistance (*R*-value) of the insulating material installed either between the roof framing or continuously on the roof assembly shall be as specified in Table C402.1.3, based on construction materials used in the roof assembly. Insulation installed on a suspended ceiling having removable ceiling tiles shall not be considered as part of the minimum thermal resistance of the roof insulation. Continuous insulation board shall be installed in not less than 2 layers and the edge joints between each layer of insulation shall be staggered.

Exceptions:

1. ~~Continuously insulated roof assemblies where the thickness of insulation varies 1 inch (25 mm) or less and where the area-weighted *U*-factor is equivalent to the same assembly with the *R*-value specified in Table C402.1.3.~~
 2. ~~1.~~ Where tapered insulation is used with insulation entirely above deck, the *R*-value where the insulation thickness varies 1 inch (25 mm) or ~~less~~ more from the minimum thickness of tapered insulation shall comply with the *R*-value specified in Table C402.1.3.
 3. ~~2.~~ Two layers of insulation are not required where insulation tapers to the roof deck, such as at roof drains.

Reason: The goal of this proposal is to repair and preserve the intent in original proposal EC31-03/04 (AM PC) by New Buildings Institute which correctly added a “first-ever” use of an R-value equivalent, area-weighted average U-factor option in lieu of an “R-value only” compliance option.

The clear intent in the “charging” paragraph of Section C402.2 is to limit its following sub-sections (C402.2.1 Roofs, C402.2.2 Walls, C402.2.3 Floors, etc.) solely to R-value compliance by way of Table C402.1.3.

Accordingly, this proposal is limited solely to correctly distinctly separating and relocating the appropriate U-factor alternative as a subsection to C402.1.4 where it belongs. NRCA proposed this for roof/ceiling installations only as roofing and related professions is our charge. We leave it to others, then, to clean the remaining instances throughout C402.2 where R-value compliance and U-factor compliance are mixed and co-matched inappropriately within C402.2.

The proposal preserves the independent expressions of 1) minimum thickness, 2) staggered joints and 3) back-loaded, suspended ceilings from C402.2.1, as appropriate.

It is unnecessary to preserve the minimum “skylight curb” provision of C402.2.1.1 as the Assembly U-factor, C-factor or F-factor-based method provides the user with maximum flexibility toward achieving assembly U-factor, C-factor or F-factor-based compliance in roof/ceiling construction in accordance with Table C402.1.4, accepted engineering and architectural practice.

The proposal is product neutral and inclusive of all rigid board insulation types including, cellular glass, expanded and extruded polystyrene, faced and fiber-reinforced gypsum board, stone wool, perlite board, polyisocyanurate, high-density polyisocyanurate, wood fiber board and composite board.

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, as the provisions of **C402.1.4, Assembly U-factor, C-factor or F-factor-based methodolog[ies]**, remain a design option addressing constructability issues in new construction and reroofing projects even without the change, and where a newly proposed or existing roof deck does not provide adequate slope for positive drainage.

Proposal # 5308

CE72-19

CE73-19

IECC: TABLE C402.1.4

Proponent: Daniel Bresette, Alliance to Save Energy, representing Alliance to Save Energy (dbresette@ase.org); Maureen Guttman, representing BCAP-IBTS (mguttpgh@aol.com)

2018 International Energy Conservation Code

Revise as follows:

TABLE C402.1.4
OPAQUE THERMAL ENVELOPE ASSEMBLY MAXIMUM REQUIREMENTS, *U*-FACTOR METHOD^{a, b}

CLIMATE ZONE	1		2		3		4 EXCEPT MARINE		5 AND MARINE 4		6		7		
	All other	Group R	All other	Group R	All other	Group R	All other	Group R	All other	Group R	All other	Group R	All other	Group R	All other
Roofs															
Insulation entirely above roof deck	U-0.048	U-0.039	U-0.039	U-0.039	U-0.039	U-0.039	U-0.032	U-0.032	U-0.032	U-0.032	U-0.032	U-0.032	U-0.028	U-0.028	U-0.028
Metal buildings	U-0.044 U-0.035	U-0.035	U-0.035	U-0.035	U-0.035	U-0.035	U-0.035	U-0.035	U-0.035	U-0.035	U-0.031	U-0.031	U-0.029	U-0.029	U-0.029
Attic and other	U-0.027	U-0.027	U-0.027	U-0.027	U-0.027	U-0.027	U-0.027	U-0.027	U-0.027	U-0.021	U-0.021	U-0.021	U-0.021	U-0.021	U-0.021

For SI: 1 pound per square foot = 4.88 kg/m², 1 pound per cubic foot = 16 kg/m³.

ci = Continuous insulation, NR = No Requirement, LS = Liner System.

- Where assembly *U*-factors, *C*-factors, and *F*-factors are established in ANSI/ASHRAE/IESNA 90.1 Appendix A, such opaque assemblies shall be a compliance alternative where those values meet the criteria of this table, and provided that the construction, excluding the cladding system on walls, complies with the appropriate construction details from ANSI/ASHRAE/ISNEA 90.1 Appendix A.
- Where *U*-factors have been established by testing in accordance with ASTM C1363, such opaque assemblies shall be a compliance alternative where those values meet the criteria of this table. The *R*-value of continuous insulation shall be permitted to be added to or subtracted from the original tested design.
- Where heated slabs are below grade, below-grade walls shall comply with the *U*-factor requirements for above-grade mass walls.
- "Mass floors" shall be in accordance with Section C402.2.3.
- These *C*-, *F*- and *U*-factors are based on assemblies that are not required to contain insulation.
- The first value is for perimeter insulation and the second value is for full slab insulation.
- "Mass walls" shall be in accordance with Section C402.2.2.

Reason: The purpose of this code change proposal is to correct the U-factor for roof insulation for All Other metal buildings in climate zone 1. Even though the R-values in Table C402.1.3 for both Group R and All Other metal buildings in climate zone 1 are R-19+R 11 LS, the U-factor table applies a higher U-factor for All Other metal buildings. This proposal adopts the U-factor from Group R for both building types in climate zone 1, since it is closest to the R-19+R-11 LS U-factor equivalent in Table A2.3.3 in ASHRAE Standard 90.1 Normative Appendix A. The building envelope typically remains the same for many years after construction and it is particularly important to “get it right” at the time of construction. After all, the intent of the IECC (C101.3) 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 not increase or decrease the cost of construction. The current metal building roof U-factor for All Other buildings is an error and is inconsistent with the R-value equivalent in Table C402.1.3.

Proposal # 4207

CE73-19

CE74-19

IECC: TABLE C402.1.4

Proponent: Daniel Bresette, Alliance to Save Energy, representing Alliance to Save Energy (dbresette@ase.org); Maureen Guttman, representing BCAP-IBTS (mguttpgh@aol.com)

2018 International Energy Conservation Code

Revise as follows:

TABLE C402.1.4

OPAQUE THERMAL ENVELOPE ASSEMBLY MAXIMUM REQUIREMENTS, *U*-FACTOR METHOD^{a, b}

Portions of table not shown remain unchanged.

CLIMATE ZONE	1		2		3		4 EXCEPT MARINE		5 AND MARINE 4		6		7		
	All other	Group R	All other	Group R	All other	Group R	All other	Group R	All other	Group R	All other	Group R	All other	Group R	All other
Walls, above grade															
Mass ^g	U-0.151	U-0.151	U-0.151	U-0.123	U-0.123	U-0.104	U-0.104	U-0.090	U-0.090	U-0.080	U-0.080	U-0.071	U-0.071	U-0.071	U-0.064
Metal building	U-0.079	U-0.079	U-0.079	U-0.079	U-0.079	U-0.052	U-0.052	U-0.052	U-0.052	U-0.052	U-0.052	U-0.052	U-0.052	U-0.039	U-0.052
Metal framed	U-0.077	U-0.077	U-0.077	U-0.064	U-0.064	U-0.064	U-0.064	U-0.064	U-0.064	U-0.064	U-0.064	U-0.064	U-0.064	U-0.052	U-0.064
Wood framed and other ^c	U-0.064	U-0.064	U-0.064	U-0.064	U-0.064	U-0.064	U-0.064	U-0.064	U-0.064	U-0.064	U-0.051	U-0.051	U-0.051	U-0.051	U-0.039

For SI: 1 pound per square foot = 4.88 kg/m², 1 pound per cubic foot = 16 kg/m³.

ci = Continuous insulation, NR = No Requirement, LS = Liner System.

- Where assembly *U*-factors, *C*-factors, and *F*-factors are established in ANSI/ASHRAE/IESNA 90.1 Appendix A, such opaque assemblies shall be a compliance alternative where those values meet the criteria of this table, and provided that the construction, excluding the cladding system on walls, complies with the appropriate construction details from ANSI/ASHRAE/IESNA 90.1 Appendix A.
- Where *U*-factors have been established by testing in accordance with ASTM C1363, such opaque assemblies shall be a compliance alternative where those values meet the criteria of this table. The *R*-value of continuous insulation shall be permitted to be added to or subtracted from the original tested design.
- Where heated slabs are below grade, below-grade walls shall comply with the *U*-factor requirements for above-grade mass walls.
- "Mass floors" shall be in accordance with Section C402.2.3.

- e. These *C*-, *F*- and *U*-factors are based on assemblies that are not required to contain insulation.
- f. The first value is for perimeter insulation and the second value is for full slab insulation.
- g. “Mass walls” shall be in accordance with Section C402.2.2.

Reason: The purpose of this code change proposal is to correct an apparent error in the U-factor for above-grade mass walls in climate zone 8. Table C402.1.3 of the 2018 IECC requires R-25 continuous insulation for both Group R and All Other building types, but the U-factor is significantly higher than what would be considered equivalent in Normative Appendix A of ASHRAE Standard 90.1-2016. Revising the U-factor to 0.037 for climate zone 8 will apply a consistent set of requirements across the R-value and U-factor tables. The building envelope typically remains the same for many years after construction and it is particularly important to “get it right” at the time of construction. After all, the intent of the IECC (C101.3) 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 not increase or decrease the cost of construction. The current above grade mass wall U-factor for climate zone 8 is an error and is inconsistent with the R-value equivalent in Table C402.1.3.

Proposal # 4212

CE74-19

CE75-19

IECC: TABLE C402.1.4

Proponent: Daniel Bresette, Alliance to Save Energy, representing Alliance to Save Energy (dbresette@ase.org); Maureen Guttman, representing BCAP-IBTS (mguttpgh@aol.com)

2018 International Energy Conservation Code

Revise as follows:

TABLE C402.1.4

OPAQUE THERMAL ENVELOPE ASSEMBLY MAXIMUM REQUIREMENTS, *U*-FACTOR METHOD^{a, b}

Portions of table not shown remain unchanged.

CLIMATE ZONE	1		2		3		4 EXCEPT MARINE		5 AND MARINE 4		6		7		
	All other	Group R	All other	Group R	All other	Group R	All other	Group R	All other	Group R	All other	Group R	All other	Group R	All other
Walls, above grade															
Mass ⁹	U-0.151	U-0.151	U-0.151	U-0.123	U-0.123	U-0.104	U-0.104	U-0.090	U-0.090	U-0.080	U-0.080	U-0.071	U-0.071	U-0.071	U-0.064
Metal building	U-0.079	U-0.079	U-0.079	U-0.079	U-0.079	U-0.052	U-0.052	U-0.052	U-0.052	U-0.052	U-0.052	U-0.052	U-0.052	U-0.039	U-0.052
Metal framed	U-0.077	U-0.077	U-0.077	U-0.064	U-0.064	U-0.064	U-0.064	U-0.064	U-0.064	U-0.064	U-0.064	U-0.064	U-0.064	U-0.052 U-0.042	U-0.064
Wood framed and other ^c	U-0.064	U-0.064	U-0.064	U-0.064	U-0.064	U-0.064	U-0.064	U-0.064	U-0.064	U-0.064 U-0.051	U-0.051	U-0.051	U-0.051	U-0.051	U-0.039

For SI: 1 pound per square foot = 4.88 kg/m², 1 pound per cubic foot = 16 kg/m³.

ci = Continuous insulation, NR = No Requirement, LS = Liner System.

- Where assembly *U*-factors, *C*-factors, and *F*-factors are established in ANSI/ASHRAE/IESNA 90.1 Appendix A, such opaque assemblies shall be a compliance alternative where those values meet the criteria of this table, and provided that the construction, excluding the cladding system on walls, complies with the appropriate construction details from ANSI/ASHRAE/IESNA 90.1 Appendix A.
- Where *U*-factors have been established by testing in accordance with ASTM C1363, such opaque assemblies shall be a compliance alternative where those values meet the criteria of this table. The *R*-value of continuous insulation shall be permitted to be added to or subtracted from the original tested design.
- Where heated slabs are below grade, below-grade walls shall comply with the *U*-factor requirements for above-grade mass walls.

- d. "Mass floors" shall be in accordance with Section C402.2.3.
- e. These *C*-, *F*- and *U*-factors are based on assemblies that are not required to contain insulation.
- f. The first value is for perimeter insulation and the second value is for full slab insulation.
- g. "Mass walls" shall be in accordance with Section C402.2.2.

Reason: The purpose of this code change proposal is to correct two errors in the U-factor for wall insulation in climate zones 5 and 7. In both cases, the U-factor does not match the corresponding R-value of the IECC. The proposal above not only brings the U-factor into alignment with the IECC R-value, but also brings it into alignment with the applicable U-factors and R-values in ASHRAE Standard 90.1-2016.

In climate zone 7, Group R metal-framed walls are required to be insulated to R-13+R-15.6 c.i. in both the IECC and ASHRAE Standard 90.1. ASHRAE Standard 90.1 includes an equivalent U-factor of 0.042, which corresponds with the R-value according to Standard 90.1 Normative Appendix A. However, the 2018 IECC includes an equivalent U-factor of 0.052, which is inconsistent. We believe the IECC U-factor is an error and should be changed to 0.042.

In climate zone 5, Group R wood-framed walls are required to be insulated to R-13+R-7.5 c.i., or R-20+R-3.8 c.i., but the U-factor equivalent clearly does not match up. ASHRAE Standard 90.1 specifies a U-factor of 0.051, which not only corresponds with the R-value, but also corresponds with the U-factor requirements in climate zones 6 and 7 (which also require R-13+5 + R-7.5 c.i., or R-20+R-3.8 c.i.). Here again, we believe the IECC U-factor is an error, and should be changed to 0.051.

The building envelope typically remains the same for many years after construction and it is particularly important to "get it right" at the time of construction. After all, the intent of the IECC (C101.3) 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 not increase or decrease the cost of construction. The current U-factor equivalents for metal-framed walls in climate zone 7 and wood-framed walls in climate zone 5 are errors and are inconsistent with the R-value equivalent in Table C402.1.3.

Proposal # 5224

CE75-19

CE76-19

IECC: TABLE C402.1.4

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 C402.1.4
OPAQUE THERMAL ENVELOPE ASSEMBLY MAXIMUM REQUIREMENTS, U-FACTOR METHOD^{a, b}

CLIMATE ZONE	1		2		3		4 EXCEPT MARINE		5 AND MARINE 4		6		7	
	All other	Group R	All other	Group R	All other	Group R	All other	Group R	All other	Group R	All other	Group R	All other	Group R
Roofs														
Insulation entirely above roof deck	U-0.048	U-0.039	U-0.039	U-0.039	U-0.039	U-0.039	U-0.032	U-0.032	U-0.032	U-0.032	U-0.032	U-0.032	U-0.028	U-0.028
Metal buildings	U-0.044	U-0.035	U-0.035	U-0.035	U-0.035	U-0.035	U-0.035	U-0.035	U-0.035	U-0.035	U-0.031	U-0.031	U-0.029	U-0.029
Attic and other	U-0.027	U-0.027	U-0.027	U-0.027	U-0.027	U-0.027	U-0.027	U-0.027	U-0.027	U-0.021	U-0.021	U-0.021	U-0.021	U-0.021
Walls, above grade														
Mass ^{g, f}	U-0.151	U-0.151	U-0.151	U-0.123	U-0.123	U-0.104	U-0.104	U-0.090	U-0.090	U-0.080	U-0.080	U-0.071	U-0.071	U-0.071
Metal building	U-0.079	U-0.079	U-0.079	U-0.079	U-0.079	U-0.052	U-0.052	U-0.052	U-0.052	U-0.052	U-0.052	U-0.052	U-0.052	U-0.052
Metal framed	U-0.077	U-0.077	U-0.077	U-0.064	U-0.064	U-0.064	U-0.064	U-0.064	U-0.064	U-0.064	U-0.064	U-0.064	U-0.064	U-0.064
Wood framed and other ^c	U-0.064	U-0.064	U-0.064	U-0.064	U-0.064	U-0.064	U-0.064	U-0.064	U-0.064	U-0.064	U-0.051	U-0.051	U-0.051	U-0.051
Walls, below grade														
Below-grade wall ^c	C-1.140 ^e	C-1.140 ^e	C-1.140 ^e	C-1.140 ^e	C-1.140 ^e	C-1.140 ^e	C-0.119	C-0.119	C-0.119	C-0.119	C-0.119	C-0.119	C-0.092	C-0.092
Floors														
Mass ^d	U-0.322 ^e	U-0.322 ^e	U-0.107	U-0.087	U-0.076	U-0.076	U-0.076	U-0.074	U-0.074	U-0.064	U-0.064	U-0.064	U-0.055	U-0.055
Joist/framing	U-0.066 ^e	U-0.066 ^e	U-0.033	U-0.033	U-0.033	U-0.033	U-0.033	U-0.033	U-0.033	U-0.033	U-0.033	U-0.033	U-0.033	U-0.033
Slab-on-grade floors														

Unheated slabs	F-0.73 ^e	F-0.73 ^e	F-0.73 ^e	F-0.73 ^e	F-0.73 ^e	F-0.73 ^e	F-0.54	F-0.54	F-0.54	F-0.54	F-0.54	F-0.52	F-0.40	F-0.40
Heated slabs ^f	F-1.02 F-0.74 <u>0.69</u>	F-1.02 F-0.74 <u>0.69</u>	F-1.02 F-0.74 <u>0.69</u>	F-1.02 F-0.74 <u>0.69</u>	F-0.90 F-0.74 <u>0.66</u>	F-0.90 F-0.74 <u>0.66</u>	F-0.86 F-0.64 <u>0.62</u>	F-0.86 F-0.64 <u>0.62</u>	F-0.79 F-0.64 <u>0.62</u>	F-0.79 F-0.64 <u>0.62</u>	F-0.79 F-0.55 <u>0.62</u>	F-0.69 F-0.55 <u>0.602</u>	F-0.69 F-0.55 <u>0.602</u>	F-0.69 F-0.55 <u>0.602</u>
Opaque doors														
Swinging door	U-0.61	U-0.61	U-0.61	U-0.61	U-0.61	U-0.61	U-0.61	U-0.61	U-0.37	U-0.37	U-0.37	U-0.37	U-0.37	U-0.37
Garage door <14% glazing	U-0.31	U-0.31	U-0.31	U-0.31	U-0.31	U-0.31	U-0.31	U-0.31	U-0.31	U-0.31	U-0.31	U-0.31	U-0.31	U-0.31

For SI: 1 pound per square foot = 4.88 kg/m², 1 pound per cubic foot = 16 kg/m³.

ci = Continuous insulation, NR = No Requirement, LS = Liner System.

- a. Where assembly *U*-factors, *C*-factors, and *F*-factors are established in ANSI/ASHRAE/IESNA 90.1 Appendix A, such opaque assemblies shall be a compliance alternative where those values meet the criteria of this table, and provided that the construction, excluding the cladding system on walls, complies with the appropriate construction details from ANSI/ASHRAE/IESNA 90.1 Appendix A.
- b. Where *U*-factors have been established by testing in accordance with ASTM C1363, such opaque assemblies shall be a compliance alternative where those values meet the criteria of this table. The *R*-value of continuous insulation shall be permitted to be added to or subtracted from the original tested design.
- c. Where heated slabs are below grade, below-grade walls shall comply with the *U*-factor requirements for above-grade mass walls.
- d. "Mass floors" shall be in accordance with Section C402.2.3.
- e. These *C*-, *F*- and *U*-factors are based on assemblies that are not required to contain insulation.
- f. ~~The first value is for perimeter insulation and the second value is for full slab insulation.~~
- g. "Mass walls" shall be in accordance with Section C402.2.2.

Reason: The *F*-factors for heated slabs in Table C402.1.4 are currently shown as two separate factors for the two insulation components. This is technically incorrect and has caused confusion for the following reasons:

1. *F*-factors are like *U*-factors in that they represent the net effect of all insulation materials applied to an assembly. Thus, there should only be one *F*-factor representing the *R*-value of any and all insulation materials used on the slab construction. In this case, one *F*-factor should be used to represent the combined effect of perimeter and full slab insulation *R*-values required in Table C402.1.3 for heated slabs.
2. For evaluating alternative insulation solutions (such as by using COMcheck), one must apply a single *F*-factor to the slab construction. Without this corrected in the code, making alternative solutions to the *R*-value table will become confused and potentially non-compliant or unavailable. For example, the revised *F*-factors as proposed are consistent with *F*-factors in the ASHRAE 90.1 standard's Appendix A (pending final approval of Addendum bx) which is referenced in footnote 'a' of this Table C402.1.4. This consistency is important for code compliance and flexibility to determine alternate solutions. It is also for this reason that some of the *F*-factors have two significant digits while others have three – exactly as done in ASHRAE 90.1 Appendix A as already referenced in footnote 'a'.

3. The current “dual” F-factors was the inadvertent outcome of last code cycle in attempting to do the best that could be done at that time to make a needed improvement to the code while reasonably resolving several competing proposals and public comments (see proposal CE61-16 (AMPC2) from last code cycle).

4. Footnote ‘f’ was developed as a “patch” for the 2018 code until a better F-factor solution could be developed as done in this current proposal. Thus, with the F-factor corrections in this proposal, footnote ‘f’ is no longer needed to give direction for appropriate use of a single F-factor to determine equivalent R-value requirements when insulation is used in multiple locations (e.g., at perimeter and fullslab). The means to determine alternative F-factors is already addressed in footnote ‘a’ referencing ASHRAE 90.1 Appendix A data.

This proposal resolves all of the above issues and will provide greater flexibility for compliance by providing a means to use a single F-factor to determine a variety of alternative R-values for any combination of perimeter and full-slab insulation, not just those shown in the R-value Table C402.1.3.

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

This proposal is a correction to the heated slab F-factors to ensure appropriate use, consistency with the R-value requirements (which combine perimeter and full-slab insulation), and to allow alternatives to be determined using tools like COMcheck and ASHRAE 90.1 Appendix A. It does not change the stringency of the requirements.

Proposal # 4515

CE76-19

CE77-19

IECC: TABLE C402.1.4

Proponent: Joseph Hetzel, representing Door & Access Systems Manufacturers Association
(Jhetzel@thomasamc.com)

2018 International Energy Conservation Code

Revise as follows:

TABLE C402.1.4
OPAQUE THERMAL ENVELOPE ASSEMBLY MAXIMUM REQUIREMENTS, U-FACTOR METHOD^{a, b}

CLIMATE ZONE	1		2		3		4 EXCEPT MARINE		5 AND MARINE 4		6		7	
	All other	Group R	All other	Group R	All other	Group R	All other	Group R	All other	Group R	All other	Group R	All other	Group R
Roofs														
Insulation entirely above roof deck	U-0.048	U-0.039	U-0.039	U-0.039	U-0.039	U-0.039	U-0.032	U-0.032	U-0.032	U-0.032	U-0.032	U-0.032	U-0.028	U-0.028
Metal buildings	U-0.044	U-0.035	U-0.035	U-0.035	U-0.035	U-0.035	U-0.035	U-0.035	U-0.035	U-0.035	U-0.031	U-0.031	U-0.029	U-0.029
Attic and other	U-0.027	U-0.027	U-0.027	U-0.027	U-0.027	U-0.027	U-0.027	U-0.027	U-0.027	U-0.021	U-0.021	U-0.021	U-0.021	U-0.021
Walls, above grade														
Mass ^g	U-0.151	U-0.151	U-0.151	U-0.123	U-0.123	U-0.104	U-0.104	U-0.090	U-0.090	U-0.080	U-0.080	U-0.071	U-0.071	U-0.071
Metal building	U-0.079	U-0.079	U-0.079	U-0.079	U-0.079	U-0.052	U-0.052	U-0.052	U-0.052	U-0.052	U-0.052	U-0.052	U-0.052	U-0.039
Metal framed	U-0.077	U-0.077	U-0.077	U-0.064	U-0.064	U-0.064	U-0.064	U-0.064	U-0.064	U-0.064	U-0.064	U-0.064	U-0.064	U-0.052
Wood framed and other ^c	U-0.064	U-0.064	U-0.064	U-0.064	U-0.064	U-0.064	U-0.064	U-0.064	U-0.064	U-0.064	U-0.051	U-0.051	U-0.051	U-0.051
Walls, below grade														
Below-grade wall ^c	C-1.140 ^e	C-1.140 ^e	C-1.140 ^e	C-1.140 ^e	C-1.140 ^e	C-1.140 ^e	C-0.119	C-0.119	C-0.119	C-0.119	C-0.119	C-0.119	C-0.092	C-0.092
Floors														
Mass ^d	U-0.322 ^e	U-0.322 ^e	U-0.107	U-0.087	U-0.076	U-0.076	U-0.076	U-0.074	U-0.074	U-0.064	U-0.064	U-0.064	U-0.055	U-0.051
Joist/framing	U-0.066 ^e	U-0.066 ^e	U-0.033	U-0.033	U-0.033	U-0.033	U-0.033	U-0.033	U-0.033	U-0.033	U-0.033	U-0.033	U-0.033	U-0.033
Slab-on-grade floors														

Unheated slabs	F-0.73 ^e	F-0.73 ^e	F-0.73 ^e	F-0.73 ^e	F-0.73 ^e	F-0.73 ^e	F-0.54	F-0.54	F-0.54	F-0.54	F-0.54	F-0.52	F-0.40	F-0.40
Heated slabs ^f	F-1.02 0.74	F-1.02 0.74	F-1.02 0.74	F-1.02 0.74	F-0.90 0.74	F-0.90 0.74	F-0.86 0.64	F-0.86 0.64	F-0.79 0.64	F-0.79 0.64	F-0.79 0.55	F-0.69 0.55	F-0.69 0.55	F-0.69 0.55
Opaque doors														
Swinging door	U-0.61	U-0.61	U-0.61	U-0.61	U-0.61	U-0.61	U-0.61	U-0.61	U-0.37	U-0.37	U-0.37	U-0.37	U-0.37	U-0.37
Garage door <14% glazing ^h	U-0.31	U-0.31	U-0.31	U-0.31	U-0.31	U-0.31	U-0.31	U-0.31	U-0.31	U-0.31	U-0.31	U-0.31	U-0.31	U-0.31

For SI: 1 pound per square foot = 4.88 kg/m², 1 pound per cubic foot = 16 kg/m³.

ci = Continuous insulation, NR = No Requirement, LS = Liner System.

- a. Where assembly *U*-factors, *C*-factors, and *F*-factors are established in ANSI/ASHRAE/IESNA 90.1 Appendix A, such opaque assemblies shall be a compliance alternative where those values meet the criteria of this table, and provided that the construction, excluding the cladding system on walls, complies with the appropriate construction details from ANSI/ASHRAE/ISNEA 90.1 Appendix A.
- b. Where *U*-factors have been established by testing in accordance with ASTM C1363, such opaque assemblies shall be a compliance alternative where those values meet the criteria of this table. The *R*-value of continuous insulation shall be permitted to be added to or subtracted from the original tested design.
- c. Where heated slabs are below grade, below-grade walls shall comply with the *U*-factor requirements for above-grade mass walls.
- d. "Mass floors" shall be in accordance with Section C402.2.3.
- e. These *C*-, *F*- and *U*-factors are based on assemblies that are not required to contain insulation.
- f. The first value is for perimeter insulation and the second value is for full slab insulation.
- g. "Mass walls" shall be in accordance with Section C402.2.2.
- h. Garage doors having a single row of fenestration shall have an assembly U-factor less than or equal to 0.44 in Climate Zones 1 through 6 and less than or equal to 0.36 in Climate Zones 7 and 8, provided that the fenestration area is not less than 14 percent and not more than 25 percent of the total door area.

Reason: This proposal clarifies U-factor requirements for garage doors with glazing making up between 14% and 25% of the door area. This footnote will complete the garage door U-factor requirements in the code, allowing for non-glazed (<14% glazing), vision lights or one row of glazing (14% - 25% glazing), or fenestration (>50% glazing.) Garage doors are not designed with glazing constituting between 25% and 50% of the door area. The U-factor values in the proposed footnote are based on DASMA research involving one row of glazing in sectional doors.

Cost Impact: The code change proposal will decrease the cost of construction. The code change proposal will decrease the cost of construction. Currently, there is no prescriptive means of determining the maximum U-factor requirement for garage doors with between 14% and 25% glazing. If the U-factor requirement is obtained from the chart for garage doors with less than 14% glazing, or is obtained from the fenestration (greater than 50% glazing) charts, the values are unrealistically conservative. The proposed U-factors are based on sound testing, and the clarified requirements would theoretically lower

construction costs.

Proposal # 3959

CE77-19

CE78-19 Part I

PART I — IECC: C402.2.4, C402.2.4.1(New)

PART II — IECC: R402.2.10 (IRC N1102.2.10), R402.2.10.1 [IRC N1102.2.10.1] (New)

Proponent: William Warlick, representing Self (william.warlick@slcgov.com); Don Davies (don.davies@slcgov.com)

2018 International Energy Conservation Code

Revise as follows:

~~**C402.2.4 Slabs-on-grade perimeter insulation- Slab-on-grade floors (Mandatory).** Where the slab-on-grade is in contact with the ground, the minimum thermal resistance (*R*-value) of the insulation around the perimeter of unheated or heated slab-on-grade floors. A slab-on-grade floor designed in accordance with the *R*-value method of Section C402.1.3 shall be as specified in Table C402.1.3. The perimeter insulation shall be placed on the outside of the foundation or on the inside of the foundation wall. The perimeter insulation shall extend downward from the top of the slab for the minimum distance shown in the table or to the top of the footing, whichever is less, or downward to not less than the bottom of the slab and then horizontally to the interior or exterior for the total distance shown in the table. Insulation extending away from the building shall be protected by pavement or by not less than of 10 inches (254 mm) of soil. insulated in accordance with this section and Table C402.1.3.~~

Exception: Where the slab-on-grade floor is greater than 24 inches (61 mm) below the finished exterior grade ~~perimeter insulation is not required.~~

Add new text as follows:

C402.2.4.1 Construction. The insulation shall be placed around the foundation perimeter on the outside of the foundation or on the inside of the foundation wall. The perimeter insulation shall extend downward from the top of the slab for downward the minimum distance shown in Table C402.1.3 or to the top of the footing, whichever is less, or downward to not less than the bottom of the slab and then horizontally to the interior or exterior for the total distance shown in the table. Insulation extending away provided in Table C402.1.3 by any combination of vertical placement, extending under the slab or extending out from the building. Insulation extending out from the building shall be protected by pavement or by not less than of 10 inches (254 mm) of soil.

Exceptions:

1. In vertical placement the insulation shall be permitted to extend downward the distance shown in the table or to the top of the footing.
2. Preservative-treated wood or other approved thermal break material shall be permitted to substitute for the top 3-1/2 inches of insulation between the foundation wall and the edge of the floor slab.
3. Except at heated slabs or in a Group R occupancy, a thermal break of minimum 1/2 inch isolation joint material shall be permitted to substitute for the insulation between the foundation wall and the edge of the floor slab.

Proposal # 5603

CE78-19 Part I

CE78-19 Part II

IECC: R402.2.10 (IRC N1102.2.10), R402.2.10.1 [IRC N1102.2.10.1] (New)

Proponent: William Warlick, representing Self (william.warlick@slcgov.com); Don Davies (don.davies@slcgov.com)

2018 International Energy Conservation Code

Revise as follows:

R402.2.10 (IRC N1102.2.10) Slab-on-grade floors (Mandatory). ~~Slab-on-grade floors with a floor surface less than 12 inches (305 mm) below grade. A slab-on-grade floor shall be insulated in accordance with this section and 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~~

Exceptions:

1. ~~Where the slab-on-grade floor is greater than 12 inches (30 mm) below the finished exterior grade.~~
2. ~~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) Construction. ~~The insulation shall be placed around the foundation perimeter 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 insulation shall extend from the top of the slab downward the distance provided in Table R402.1.2 by any combination of vertical insulation placement, insulation extending under the slab or insulation extending out from the building. building. Insulation extending away out from the building shall be protected by pavement or by not less than 10 inches (254 mm) of soil.~~

Exceptions:

1. ~~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.~~
2. ~~Preservative-treated wood or other approved thermal break material shall be permitted to substitute for the top 1-1/2 inches of insulation between the foundation wall and the edge of the floor slab.~~

~~Slab-edge insulation shall not be required in jurisdictions designated by the code official as having a very heavy termite infestation.~~

Reason: The intent of this code change proposal is to: (1) make the insulation of slab-on-grade floors mandatory; (2) provide alternative construction solutions for insulation run inside a foundation wall; and (3) simplify and harmonize the code language.

During the life expectancy of a building insulation can readily be added to most envelope portions of the building at times, but one envelope element which will not be upgraded is the slab-on-grade insulation. Therefore, it is

important to get this insulation done right when a new building is built.

While making slab-on-grade floor insulation mandatory could entail some construction problems, this code change offers practical solutions. And while the 45-degree angle cut option provided for residential buildings has proven to be impractical in some situations, the code change offers construction options to this. Where insulation is run inside the foundation wall the joint between the slab and the foundation can be covered by preservative-treated wood. In limited applications where occupant comfort will not be critical, this insulation can be substituted by simply a thermal break.

In addition to making these substantive changes, we propose new text to simplify and clarify the code language, and to harmonize the structure of this section across the IRC and IECC Commercial and Residential sections.

Cost Impact: The code change proposal will not increase or decrease the cost of construction. Will not increase the cost of construction. Insulation provided at slab-on-grade floors would substitute for insulation at other elements of the thermal envelope, so the Mandatory provision would not add to the cost of construction.

Proposal # 5616

CE78-19 Part II

CE79-19

IECC: C402.2.4, C402.2.4.1 (New)

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

2018 International Energy Conservation Code

C402.2.4 Slabs-on-grade perimeter insulation. Slabs-on-grade. (Prescriptive) ~~Where the slab on grade is in contact with the ground, the~~ The minimum thermal resistance (R -value) of the insulation around the perimeter of ~~for~~ unheated or heated slab-on-grade floors designed in accordance with the R -value method of Section C402.1.3 shall be as specified in Table C402.1.3. ~~The perimeter insulation shall be placed on the outside of the foundation or on the inside of the foundation wall. The perimeter insulation shall extend downward from the top of the slab for the minimum distance shown in the table or to the top of the footing, whichever is less, or downward to not less than the bottom of the slab and then horizontally to the interior or exterior for the total distance shown in the table. Insulation extending away from the building shall be protected by pavement or by not less than of 10 inches (254 mm) of soil.~~ **Exception:** ~~Where the slab on-grade floor is greater than 24 inches (61 mm) below the finished exterior grade, perimeter insulation is not required.~~

Add new text as follows:

C402.2.4.1 Insulation installation (Mandatory). Where installed, the perimeter insulation shall be placed on the outside of the foundation or on the inside of the foundation wall. The perimeter insulation shall extend downward from the top of the slab for the minimum distance shown in the table or to the top of the footing, whichever is less, or downward to not less than the bottom of the slab and then horizontally to the interior or exterior for the total distance shown in the table. Insulation extending away from the building shall be protected by pavement or by not less than of 10 inches (254 mm) of soil. Where installed, full slab insulation shall be continuous under the entire area of the slab-on-grade floor, except at structural column locations and service penetrations. Insulation required at the heated slab perimeter shall not be required to extend below the bottom of the heated slab and shall be continuous with the full slab insulation.
Exception: Where the slab-on-grade floor is greater than 24 inches (61 mm) below the finished exterior grade, perimeter insulation is not required.

Reason: In the last code cycle, provisions for full-slab insulation were added to Table C402.1.3 for heated slabs. However, Section C402.2.4 only addresses perimeter insulation of slabs. This proposal makes coordinating changes to Section C402.2.4 such that installation of both perimeter insulation and full-slab insulation are addressed in a manner consistent with the intent of Table C402.1.3. The designation of [Prescriptive] and [Mandatory] in the titles is used because the R -values are prescriptive, but the installation requirements should apply to any and all compliance approaches (i.e., mandatory). This approach is also intended to be consistent with a larger proposal expected from SEHPCAC which addresses the prescriptive vs. mandatory matter in other sections of the code.

Cost Impact: The code change proposal will not increase or decrease the cost of construction. The proposal adds installation provisions for fullslab insulation in a manner consistent with Table C402.1.3. The installation provisions provided for full slab insulation may reduce cost for typical slab-on-grade floor construction by explicitly not requiring insulation under structural column footings (although this is possible using high density and compressive strength foam insulating sheathing boards as commonly done for cryogenic facilities and infrastructure frost protection).

Staff Analysis: Please note that the majority of the change is relocating existing text from Section C402.2.4 into C402.2.4.1. Because of the requirements of the cdpACCESS system, the text removed from C402.2.4 must be

shown as deleted and then underlined when it reappears in Section C402.2.4.1

Proposal # 4516

CE79-19

CE80-19

IECC: C401.2, C402.2.7, C407.2

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:

C401.2 Application. Commercial buildings shall comply with one of the following:

1. The requirements of ANSI/ASHRAE/IESNA 90.1.
2. The requirements of Sections C402 through C405 and C408. In addition, commercial buildings shall comply with Section C406 and tenant spaces shall comply with Section C406.1.1.
3. The requirements of Sections ~~C402.2.7~~, C402.5, C403.2, C403.3 through C403.3.2, C403.4 through C403.4.2.3, C403.5.5, C403.7, C403.8.1 through C403.8.4, C403.10.1 through C403.10.3, C403.11, C403.12, C404, C405, C407 and C408. The building energy cost shall be equal to or less than 85 percent of the standard reference design building.

~~C402.2.7 Airspaces. Airspaces (Mandatory).~~ Where the ~~thermal properties of airspaces are used to comply with this code~~ R-value of an airspace is used for compliance in accordance with Section ~~C401.2~~, such airspaces ~~C402.1~~ the airspace shall be enclosed in an unventilated cavity constructed to minimize airflow into and out of the enclosed airspace. Airflow shall be deemed minimized where 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.

C407.2 Mandatory requirements. Compliance with this section requires compliance with Sections ~~C402.2.7~~, C402.5, C403.2, C403.3 through C403.3.2, C403.4 through C403.4.2.3, C403.5.5, C403.7, C403.8.1 through C403.8.4, C403.10.1 through C403.10.3, C403.11, C403.12, C404 and C405.

Reason: When C402.2.7 was added in the 2018 edition of the code it required compliance with C401.2, but did not exclude the ASHRAE 90.1 compliance path.. Imposing the airspace requirement on designs which do not use Chapter 4, but use ASHRAE 90.1 prevents the 90.1 path from being a standalone path as intended. This is an opportunity for conflict and confusion and complicates training for both the IECC and the 90.1. The reference "in accordance with Section C401.2" could be read to imply that this requirement overlays those of ASHRAE 90.1. The IECC does not make modifications to the ASHRAE 90.1.

Airspaces are proposed to be non-tradeable (mandatory) in the performance path because the IECC's provisions do not include performance metrics, indicating there is no tradable value.

Instead, the IECC's requirements for airspaces are installation related – 'how to do an airspace'- which apply to all installations, prescriptive and performance, which makes the provision mandatory.

While identified as "Mandatory", if the elimination of the use of the labels "prescriptive" and "mandatory" is approved, we understand this label would not be added and it would instead the provision be added to Table C407.2 to indicate its application to the Total Building Performance compliance option.

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>

(<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 change does not increase or decrease code provisions nor impact construction methods. It clarifies language and provisions already contained in the code.

Proposal # 4182

CE80-19

CE81-19

IECC: C402.2, C402.2.8 (New)

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

2018 International Energy Conservation Code

Revise as follows:

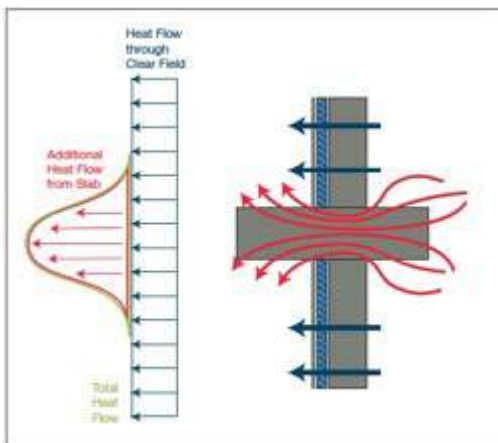
C402.2 Specific building thermal envelope insulation requirements (Prescriptive). Insulation in building thermal envelope opaque assemblies shall comply with Sections C402.2.1 through ~~C402.2.7~~ **C402.2.8** and Table C402.1.3.

Add new text as follows:

C402.2.8 Concrete slab floors. Concrete floor slabs that penetrate the building thermal envelope shall be provided with either continuous insulation having a minimum thermal resistance of R-3 or a minimum R-3 thermal break located where the concrete slab penetrates the building thermal envelope.

Reason: The requirements for overall assembly insulation have been well-addressed in the code. However, the existing requirements do not adequately address significant thermal bridging issues.

Thermal bridges are created when a relatively high thermally conductive material “bridges” through the insulating materials in the thermal envelope. Whether they penetrate all the way from the exterior to the interior of the building or only partially through the thermal envelope, thermal bridges make it easier for heat to travel in or out of the building. The impact of thermal bridges has a greater energy impact than a simple weighted U-factor calculation would suggest. Weighted U-factor calculations assume that heat travels in parallel paths through an assembly. In reality, heat also moves laterally, resulting in additional heat transmission through the assembly.



This has an impact on the heating and cooling loads of the building, as well as on the perceived comfort of space occupants. Humans perceive heat primarily through conduction, then radiation, then convection. So the presence of hot or cold surfaces due to thermal bridges can have a significant impact on thermal comfort. When the thermal envelope has hot or cold spots from thermal bridges, occupants are more likely to feel uncomfortable and respond by over-conditioning the air in the space, creating another source of energy loss.

The common practices of leaving concrete slab floor edges un-insulated and extending structural slabs through the thermal envelope to create balconies are particularly problematic and significant thermal bridges. This proposal addresses this significant issue by requiring that the thermal bridges created by concrete floor slabs

that penetrate the building thermal envelope be addressed either by providing them with thermal breaks or by encapsulating them in continuous insulation. There are products available on the market that can be used to provide a thermal break within a continuously poured slab that extends to create a balcony. Alternately, balconies can utilize alternate structural configurations that do not require turning the building into a huge radiator.

Cost Impact: The code change proposal will increase the cost of construction
This will increase the cost of construction. Cost impact will vary depending on the approach taken.

Proposal # 5177

CE81-19

CE83-19

IECC: 202 (New), C402.3

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

Add new definition as follows:

VEGETATIVE ROOF. An assembly of interacting components designed to waterproof a building's top surface that includes, by design, vegetation and related landscape elements.

Revise as follows:

C402.3 Roof solar reflectance and thermal emittance. Low-sloped roofs directly above cooled conditioned spaces in *Climate Zones* 1, 2 and 3 shall comply with one or more of the options in Table C402.3.

Exceptions: The following roofs and portions of roofs are exempt from the requirements of Table C402.3:

1. Portions of the roof that include or are covered by the following:
 - 1.1. Photovoltaic systems or components.
 - 1.2. Solar air or water-heating systems or components.
 - 1.3. Vegetative roofs, roof gardens or landscaped roofs.
 - 1.4. Above-roof decks or walkways.
 - 1.5. Skylights.
 - 1.6. HVAC systems and components, and other opaque objects mounted above the roof.
2. Portions of the roof shaded during the peak sun angle on the summer solstice by permanent features of the building or by permanent features of adjacent buildings.
3. Portions of roofs that are ballasted with a minimum stone ballast of 17 pounds per square foot [74 kg/m²] or 23 psf [117 kg/m²] pavers.
4. Roofs where not less than 75 percent of the roof area complies with one or more of the exceptions to this section.

Reason: The purpose of this proposal is to maintain consistency in terminology throughout the ICC Family of International Codes. The term vegetative roof is used and defined in the 2018 IBC Ch. 2, 15, 16 and the 2018 IECC Appendix CA, entitled Solar-Ready Zone—Commercial. The proposal retains the terms roof garden and landscaped roof consistent with similar retentions in the aforementioned I-Code references.

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 DEFINITIONS used in the ICC Family of International Codes. No change to stringency is proposed.

Proposal # 5291

CE83-19

CE84-19

IECC: TABLE C402.4

Proponent: Thomas Culp, representing the Glazing Industry Code Committee and the Aluminum Extruders Council (culp@birchpointconsulting.com); Jeff Inks, Representing the Window and Door Manufacturers Association, representing Window and Door Manufacturers Association (jinks@wdma.com); Jennifer Hatfield, representing American Architectural Manufacturers Association (jen@jhatfieldandassociates.com); Chris Mathis (chris@mathisconsulting.com)

2018 International Energy Conservation Code

Revise as follows:

TABLE C402.4
BUILDING ENVELOPE FENESTRATION MAXIMUM U-FACTOR AND SHGC REQUIREMENTS

CLIMATE ZONE	1	2	3	4 EXCEPT MARINE	5 AND MARINE 4	6	7	8
Vertical fenestration								
U-factor								
Fixed fenestration	0.50	0.50 0.45	0.46 0.42	0.38 0.36	0.38 0.36	0.36 0.34	0.29	0.29 0.26
Operable fenestration	0.65 0.62	0.65 0.60	0.60 0.54	0.45	0.45	0.43 0.42	0.37 0.36	0.37 0.32
Entrance doors	1.10 0.83	0.83 0.77	0.77 0.68	0.77 0.63	0.77 0.63	0.77 0.63	0.77 0.63	0.77 0.63
SHGC								
Orientation ^a	SEW	N	SEW	N	SEW	N	SEW	N
PF < 0.2	0.25 0.23	0.33 0.31	0.25	0.33	0.25	0.33	0.36	0.48
0.2 ≤ PF < 0.5	0.30 0.28	0.37 0.34	0.30	0.37	0.30	0.37	0.43	0.53
PF ≥ 0.5	0.40 0.37	0.40 0.37	0.40	0.40	0.40	0.40	0.58	0.58
Skylights								
U-factor	0.75 0.70	0.65	0.55	0.50	0.50	0.50	0.50 0.44	0.50 0.41
SHGC	0.35 0.30	0.35 0.30	0.35 0.30	0.40	0.40	0.40	NR	NR

NR = No Requirement, PF = Projection Factor.

- a. "N" indicates vertical fenestration oriented within 45 degrees of true north. "SEW" indicates orientations other than "N." For buildings in the southern hemisphere, reverse south and north. Buildings located at less than 23.5 degrees latitude shall use SEW for all orientations.

Reason: The purpose of this proposal is to update the fenestration criteria based on a recent comprehensive analysis, providing additional energy savings in every zone while remaining cost-effective and practical. This

proposal will also provide consistency with the criteria approved for ASHRAE 90.1-2019 in Addendum AW, which passed with broad consensus and support of both industry groups and energy efficiency advocates. The fenestration energy performance indices (U-factor, SHGC), incremental costs, and energy savings associated with a total of 319 fenestration assemblies using different glazing, frame, spacer, and gas fill technologies were calculated to determine what performance levels showed positive life cycle energy savings in each zone using a heating scalar of 25.2 and a cooling scalar of 22.1, consistent with ASHRAE 90.1 methodology. Energy savings for different combinations of U and SHGC were calculated using the medium office and midrise apartment prototype building models developed by Pacific Northwest National Laboratory. Incremental cost data for each product combination was reviewed in consultation with the ASHRAE 90.1 Envelope Subcommittee, industry representatives, and other stakeholders. Practical considerations of potential limitations of different technologies in different applications, distinctions between product categories, product costs, supply and distribution were also used in shaping the final proposed requirements. This analysis resulted in the comprehensive update to ASHRAE 90.1 in Addendum AW, and those same values are adapted into IECC's different table format in this proposal.

Depending on zone, U-factors are reduced by 0-14% for fixed and operable vertical fenestration, 7-25% for entrance doors, and 0-18% for skylights; SHGC requirements for vertical fenestration and skylights are reduced by 0-14%. Overall, this proposal provides the next step in energy efficiency while relying on commercially available and cost-effective technologies, including increased use of new low-e glass coatings, high performance thermally broken or composite frames, argon gas fill, and warm edge spacers. Additionally, consistency between IECC and ASHRAE 90.1 will improve use and compliance of both standards for the design community, fenestration industry, and building code officials.

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

As described above, the ASHRAE 90.1 fenestration workgroup and envelope subcommittee assessed the incremental cost, energy savings, and life cycle cost effectiveness for 319 fenestration assemblies using a wide range of commercially available technologies: 37 different glazing assemblies (double, triple glazing with different low-e products), 4 levels of frame performance, 3 levels of spacer performance, and 2 different gas fills. Incremental cost data for each product combination was reviewed in consultation with the ASHRAE 90.1 Envelope Subcommittee, industry representatives, and other stakeholders. Life cycle energy savings were assessed in the PNNL medium office and midrise apartment prototype building models in each climate zone using a heating scalar of 25.2 and a cooling scalar of 22.1, and the proposed changes showed positive life cycle energy savings in accordance with ASHRAE 90.1 methodology.

Life cycle analysis was the primary method for determination of cost effectiveness. Nonetheless, simple payback periods for the PNNL medium office building typically ranges from 0-16 years in zones 1-7, and approximately 24 years in zone 8 where the jump from double to triple glazing in the model building increases the apparent payback period. In reality, triple glazing is already common in this extremely cold region (e.g. north slope of Alaska).

Proposal # 4764

CE84-19

CE85-19

IECC: TABLE C402.4

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 C402.4
BUILDING ENVELOPE FENESTRATION MAXIMUM U-FACTOR AND SHGC REQUIREMENTS

CLIMATE ZONE	1	2	3	4 EXCEPT MARINE	5 AND MARINE 4	6	7	8
Vertical fenestration								
U-factor								
Fixed fenestration	0.50	0.50 0.45	0.46 0.42	0.38 0.36	0.38 0.36	0.36 0.34	0.29	0.29 0.26
Operable fenestration	0.65 0.62	0.65 0.60	0.60 0.54	0.45	0.45	0.43 0.42	0.37 0.36	0.37 0.32
Entrance doors	1.10 0.83	0.83 0.77	0.77 0.68	0.77 0.63	0.77 0.63	0.77 0.63	0.77 0.63	0.77 0.63
SHGC								
Orientation ^a	SEW	N	SEW	N	SEW	N	SEW	N
PF < 0.2	0.25	0.33	0.25	0.33	0.25	0.33	0.36	0.48
0.2 ≤ PF < 0.5	0.30	0.37	0.30	0.37	0.30	0.37	0.43	0.53
PF ≥ 0.5	0.40	0.40	0.40	0.40	0.40	0.40	0.58	0.58
Skylights								
U-factor	0.75	0.65	0.55	0.50	0.50	0.50	0.50	0.50
SHGC	0.35	0.35	0.35	0.40	0.40	0.40	NR	NR

NR = No Requirement, PF = Projection Factor.

- a. "N" indicates vertical fenestration oriented within 45 degrees of true north. "SEW" indicates orientations other than "N." For buildings in the southern hemisphere, reverse south and north. Buildings located at less than 23.5 degrees latitude shall use SEW for all orientations.

Reason: The purpose of this code change proposal is to upgrade and improve U-factors for fixed and operable vertical fenestration and entrance doors in order to save energy and reduce energy cost and peak demand, consistent with the recently approved Addendum aw to ASHRAE Standard 90.1-2016, which will be part of ASHRAE Standard 90.1-2019. This proposal will improve efficiency in every climate zone, resulting in additional cost-effective energy cost savings for owners and lessors of commercial buildings and improving comfort for occupants of these buildings.

Beginning with the 2012 IECC, and continuing through subsequent editions of the code, the IECC has set U-factor requirements that properly apply irrespective of frame material type. Instead, the IECC distinguishes only between fixed and operable vertical fenestration U-factors, regardless of frame material. This change led to several positive outcomes in the IECC: (1) It improved efficiency overall in commercial buildings; (2) it greatly simplified compliance; and (3) it eliminated the unfairness from differing requirements depending on frame material type that fueled opposition by some in the window industry. Over that same period, ASHRAE continued to set U-factors specific to framing material: one set of U-factors for metal-framed products and one set for nonmetal-framed products. This has led to conflicting requirements and confusion at the state level, since the vast majority of states adopt the IECC as the primary commercial energy code, but allow compliance with ASHRAE Standard 90.1 as an alternative.

Addendum *aw*, which will become part of ASHRAE Standard 90.1-2019, will finally bring ASHRAE into general alignment with the IECC on this front by eliminating requirements that vary by framing material in favor of material-neutral “fixed” and “operable” requirements consistent with the approach already used in the IECC. This will not only help reduce confusion among design professionals, builders and code enforcement officials, but will also provide more consistent efficiency targets to fenestration manufacturers and contractors. It will also make it easier to promote the adoption of the latest model energy codes in state and local jurisdictions by removing these conflicting provisions from ASHRAE Standard 90.1. Given the recent improvement in ASHRAE values and the role of ASHRAE Standard 90.1 in the DOE commercial energy code determination process, it is now very important to improve IECC U-factors to at least match improved ASHRAE values. As a result, approving this code change proposal will help ensure consistency between the ASHRAE and IECC vertical fenestration U-factor tables for the first time since 2012 while making sure the IECC meets or exceeds ASHRAE fenestration requirements.

This proposal will also improve energy savings in commercial buildings by adopting Addendum *aw*’s moderate improvements to fenestration U-factors. These improvements are the result of significant cost and economic analyses undertaken as part of ASHRAE’s process, and Addendum *aw* was approved with broad support from manufacturers, efficiency advocates, and other stakeholders in commercial building efficiency. Improvements to the thermal envelope are a critical part of the IECC’s drive toward more efficient buildings. The efficiency of the building thermal envelope is, for the most part, set at construction, and the impact of decisions made regarding the thermal envelope will affect the building’s performance for decades. While the energy savings of this update will vary somewhat based on product type and climate zone, the overall impact on energy and cost savings from this proposal is clearly positive as found by ASHRAE.

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

Given the broad range of building types within the scope of the IECC, as well as the many products available to meet or exceed these U-factors, the cost impact will vary somewhat from one project to the next. Overall, we expect the cost impact to be very small. In some cases, it may simply be a matter of selecting a different product already available, with no cost difference at all. Our understanding is that each U-factor selected by ASHRAE for Addendum *aw* has gone through a rigorous energy-savings and cost-effectiveness analysis, so even in cases where construction costs are increased, the improvements will be cost-effective and beneficial over the useful life of the product.

Proposal # 4112

CE85-19

CE86-19

IECC: TABLE C402.4

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 C402.4
BUILDING ENVELOPE FENESTRATION MAXIMUM U-FACTOR AND SHGC REQUIREMENTS

CLIMATE ZONE	1	2	3	4 EXCEPT MARINE	5 AND MARINE 4	6	7	8
Vertical fenestration								
U-factor								
Fixed fenestration	0.50	0.50	0.46	0.38	0.38	0.36	0.29	0.29
Operable fenestration	0.65	0.65	0.60	0.45	0.45	0.43	0.37	0.37
Entrance doors	1.10	0.83	0.77	0.77	0.77	0.77	0.77	0.77
SHGC								
Orientation ^a	SEW	N	SEW	N	SEW	N	SEW	N
PF < 0.2	0.25	0.33	0.25	0.33	0.25	0.33	0.36	0.48
0.2 ≤ PF < 0.5	0.30	0.37	0.30	0.37	0.30	0.37	0.43	0.53
PF ≥ 0.5	0.40	0.40	0.40	0.40	0.40	0.40	0.58	0.58
Skylights								
U-factor	0.75	0.70	0.65	0.55	0.50	0.50	0.50	0.50
SHGC	0.35	0.35	0.35	0.40	0.40	0.40	NR	NR

NR = No Requirement, PF = Projection Factor.

- a. "N" indicates vertical fenestration oriented within 45 degrees of true north. "SEW" indicates orientations other than "N." For buildings in the southern hemisphere, reverse south and north. Buildings located at less than 23.5 degrees latitude shall use SEW for all orientations.

Reason: The purpose of this code change proposal is to improve skylight U-factors in the IECC consistent with recent changes to be incorporated into ASHRAE Standard 90.1-2019 and to bring additional cost-effective energy savings to owners of commercial buildings with skylights in climate zones 1 and 6 through 8. The U-factors in this proposal reflect those approved for Addendum aw to ASHRAE Standard 90.1-2016, which will be part of the published Standard 90.1-2019 (which we expect will be referenced as an acceptable compliance option in the 2021 IECC section C401.2). Establishing consistency with ASHRAE's skylight U-factors will not only

reduce confusion among design professionals and building officials but will also provide building owners with more efficient skylights determined to be cost-effective through ASHRAE's process.

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

While we believe that many skylights currently being installed will already meet or exceed these U-factor requirements, in some cases, the lower U-factors will require the selection of a more efficient skylight or the incorporation of other energy efficient measures in the IECC's performance-based compliance options, either of which may increase costs. Although these improvements in skylight U-factors may increase costs in climate zones 1 and 6-8, we do not expect the cost increases to be significant. Our understanding is that each U-factor selected by ASHRAE for Addendum aw has gone through a rigorous energy-savings and cost-effectiveness analysis, so even in cases where construction costs are increased, the improvements will be cost-effective over the useful life of the product.

Proposal # 4195

CE86-19

CE87-19

IECC: TABLE C402.4

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, representing American Council for an Energy-Efficient Economy (misuriello@verizon.net)

2018 International Energy Conservation Code

Revise as follows:

TABLE C402.4
BUILDING ENVELOPE FENESTRATION MAXIMUM U-FACTOR AND SHGC REQUIREMENTS

CLIMATE ZONE	1	2	3	4 EXCEPT MARINE	5 AND MARINE 4	6	
Vertical fenestration							
U-factor							
Fixed fenestration	0.50	0.50	0.46	0.38	0.38	0.36	
Operable fenestration	0.65	0.65	0.60	0.45	0.45	0.43	
Entrance doors	1.10	0.83	0.77	0.77	0.77	0.77	
SHGC							
Orientation ^a	SEW	N	SEW	N	SEW	N	SEW
	Fixed	Operable	Fixed	Operable	Fixed	Operable	Fixed
PF < 0.2	0.25 0.23	0.33 0.21	0.25	0.33 0.23	0.25	0.33 0.23	0.36
0.2 ≤ PF < 0.5	0.30 0.28	0.37 0.25	0.30	0.37 0.28	0.30	0.37 0.28	0.43
PF ≥ 0.5	0.40 0.37	0.40 0.34	0.40	0.40 0.37	0.40	0.40 0.37	0.58
Skylights							
U-factor	0.75	0.65	0.55	0.50	0.50	0.50	
SHGC	0.35	0.35	0.35	0.40	0.40	0.40	

NR = No Requirement, PF = Projection Factor.

a. "N" indicates vertical fenestration oriented within 45 degrees of true north. "SEW" indicates orientations other than "N." For buildings in the southern hemisphere, reverse south and north. Buildings located at less than 23.5 degrees latitude shall use SEW for all orientations.

Reason: The purpose of this code change proposal is to save energy, reduce energy costs and peak demand, and enhance occupant comfort by improving commercial fenestration SHGCs and making the IECC's treatment reasonably consistent with Addendum aw to ASHRAE Standard 90.1-2016, which will be part of the published Standard 90.1-2019. The proposal also greatly simplifies compliance with the prescriptive fenestration SHGC requirements in the IECC by adopting ASHRAE's "fixed" and "operable" approach to setting SHGC requirements, in lieu of requiring the user to determine the orientation of each fenestration product in the building in order to apply the IECC's current orientation-specific SHGCs. This proposal also maintains projection factor adjustments that are consistent with the current IECC approach but adjusts them according to the new "fixed" and "operable" distinction. These changes will result in energy savings and peak demand savings in every climate zone, and in many cases may reduce the size of cooling equipment. The proposal will also bring greater consistency between IECC and ASHRAE SHGC requirements while reducing unnecessary confusion. The commercial IECC's prescriptive approach of incorporating orientation into its SHGC requirement has been unnecessarily complicated in recent years, and it has not provided any real efficiency or compliance benefits. The residential IECC prescriptive path has always applied a single SHGC to fenestration in each climate zone, irrespective of orientation, leaving more sophisticated design choices to the performance path, where it is more appropriate. By contrast, recent editions of the IECC have established orientation-specific SHGCs in the commercial prescriptive path by increasing the SHGC (and reducing efficiency) for northern orientations. The current SHGC division between South/East/West on one hand, and North-facing fenestration on the other, is unnecessary, less efficient, and too complicated for a prescriptive path that is most often used for simple commercial and multifamily buildings. To the extent that design professionals want to incorporate a more sophisticated solar design into a building, a performance compliance approach is a far more appropriate compliance path for such a design. The current orientation-specific SHGCs promote the idea that a design professional should incorporate a higher SHGC on the north-facing walls – an approach that is not only unlikely in practice, but potentially risky, since the wrong windows may be installed on the wrong side of the building. (Note that higher SHGCs on the north side are also less efficient; while a low SHGC is more beneficial on the other orientations, lower SHGCs provide benefits on north orientations as well.)

A better approach has been charted by ASHRAE in Addendum aw. ASHRAE sets SHGC requirements based on whether the fenestration is fixed or operable, since operable fenestration typically has larger frames and lower unit SHGCs as a result. ASHRAE does not differentiate the prescriptive SHGC requirements by orientation and has not set an artificially high and unrealistic SHGC for north-facing fenestration, recognizing that the lower SHGC is cost-effective on any side of the building. This approach has the added benefit of improving north-oriented fenestration SHGCs; these lower SHGCs were found by ASHRAE to be cost-effective (there is likely no additional cost associated with the improved SHGCs given the U-factor requirements).

While we would prefer even lower SHGCs in some climate zones, this proposal improves the SHGCs in every climate zone to varying degrees and is a step in the right direction. Low-SHGC fenestration is critically important in commercial buildings because of high daytime occupancy rates and higher internal thermal loads. Reducing solar heat gain will improve occupant comfort and may allow for the installation of smaller cooling equipment, which will not only save building owners money at construction, but again every time the equipment is replaced. Widespread use of low-SHGC fenestration (and the accompanying peak reduction) will also help reduce the need for utilities to build peaking plants or purchase peak electric power, which will ultimately benefit all utility ratepayers.

Cost Impact: The code change proposal will increase the cost of construction. While we believe that many windows currently being installed will already meet or exceed these SHGC requirements, in some cases, the lower SHGCs will require the selection of a more efficient window or the incorporation of other energy efficient measures in the IECC's performance-based compliance options, either of which may increase costs. However, since the SHGC is largely just the result of the choice of low-e coating, there may be no additional cost in most cases. Moreover, any increased glass costs may be more than offset by reduced cooling equipment costs in many cases. In any event, these SHGC values have all been thoroughly

considered in ASHRAE's energy and cost-effectiveness analyses. To the extent that the lower SHGCs increase construction costs, based on ASHRAE's work, we expect that these improvements are cost-effective over the useful life of the building.

Proposal # 4197

CE87-19

CE88-19

IECC: TABLE C402.4

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

2018 International Energy Conservation Code

Revise as follows:

TABLE C402.4
BUILDING ENVELOPE FENESTRATION MAXIMUM U-FACTOR AND SHGC REQUIREMENTS

CLIMATE ZONE	1	2	3	4 EXCEPT MARINE	5 AND MARINE 4	6	7	8
Vertical fenestration								
<u>U-factor for curtain walls, storefront, and site-built fenestration products</u>								
Fixed fenestration	0.50	0.50	0.46	0.38	0.38	0.36	0.29	0.29
Operable fenestration	0.65	0.65	0.60	0.45	0.45	0.43	0.37	0.37
<u>U-factor for Entrance Doors</u>								
Entrance doors	1.10	0.83	0.77	0.77	0.77	0.77	0.77	0.77
<u>U-factor for all other vertical fenestration</u>								
	<u>0.65</u>	<u>0.40</u>	<u>0.32</u>	<u>0.32</u>	<u>0.30</u>	<u>0.30</u>	<u>0.30</u>	<u>0.30</u>
SHGC								
Orientation ^a	SEW	N	SEW	N	SEW	N	SEW	N
PF < 0.2	0.25	0.33	0.25	0.33	0.25	0.33	0.36	0.48
0.2 ≤ PF < 0.5	0.30	0.37	0.30	0.37	0.30	0.37	0.43	0.53
PF ≥ 0.5	0.40	0.40	0.40	0.40	0.40	0.40	0.58	0.58
Skylights								
U-factor	0.75	0.65	0.55	0.50	0.50	0.50	0.50	0.50
SHGC	0.35	0.35	0.35	0.40	0.40	0.40	NR	NR

NR = No Requirement, PF = Projection Factor.

- a. "N" indicates vertical fenestration oriented within 45 degrees of true north. "SEW" indicates orientations other than "N." For buildings in the southern hemisphere, reverse south and north. Buildings located at less than 23.5 degrees latitude shall use SEW for all orientations.

Reason: The proposal modifies the fenestration table by separating requirements for "punched opening" type windows that go in a framed opening from other fenestration types such as metal curtain walls, storefront fenestration and site-build fenestration. Punched opening windows can achieve better U-factors more easily and cost-effectively than the other fenestration types, but U-factor code requirements for this window type have been held back by the technological and cost effectiveness limitations of curtain wall fenestration systems, storefrofronts and site-built products.

The 2018 IECC currently allows a 4 story multifamily building to install a less efficient window than an otherwise identical 3-story multifamily building. The only difference in the buildings from an energy standpoint is the number of floors, yet less efficient windows are allowed to be installed in the mid-rise building. This is a critical issue for midrise multifamily buildings where punched opening type windows are common, but is also an issue for other low- and mid-rise commercial buildings where they are also common.

This proposal is meant to close this loophole. It retains existing U-factor requirements for curtain walls, storefront fenestration, site-built fenestration and entrance doors (the types for which U-factor advancements are more difficult) and introduces a new category for all other fenestration that captures punched opening windows. The U-factor requirements for this category are drawn from the residential section of the code since punched opening requirements are the standard fenestration type in residential construction.

It is important to note that this proposal has been structured in a way so that it will be compatible with any other proposal that changes the existing U-factors. This proposal changes the headings and leaves the actual U-factors in place, allowing them to be modified by another proposal.

There may be some specialized circumstances where these requirements could cause technical challenges, especially high-rise buildings that are utilizing punched openings or other high-wind areas. However, this table sets the minimum for performance and these projects have other compliance paths (both modeling in the IECC and ASHRAE 90.1) to give them flexibility for these specialized circumstances, and it does not make sense to hold back the performance of the entire new construction building market for a handful of rare cases that still have other compliance options.

When these requirements were modeled relative to IECC-2015 (which has essentially the same window requirements), using the mid-rise prototype that the Pacific Northwest National Lab developed for national code determination studies, the savings ranged from 1.0-2.9% depending on climate zone (climate zone 1 is effectively the same).

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

This proposal will only increase cost for projects utilizing punched opening type fenestration. All other fenestration will be unaffected. Additionally, this proposal utilizes the values for punched openings from the the residential energy code requirements where these values have been negotiated through the ICC hearing process and found cost effective in residential.

Proposal # 5163

CE88-19

CE89-19

IECC: C402.4.1.2, C402.4.2, C402.4.4, C405.2.3, C405.2.3.1, C405.2.3.2, FIGURE C405.2.3.2, C405.2.3.3, FIGURE C405.2.3.3(1)

Proponent: Jack Bailey, representing International Association of Lighting Designers (jbailey@oneluxstudio.com); Glenn Heinmiller, Lam Partners, representing International Association of Lighting Designers (glenn@lampartners.com)

2018 International Energy Conservation Code

Revise as follows:

C402.4 Fenestration (Prescriptive). Fenestration shall comply with Sections C402.4.1 through C402.4.5 and Table C402.4. Daylight responsive controls shall comply with this section and Section C405.2.3.1.

C402.4.1.2 Increased skylight area with daylight responsive controls. The skylight area shall be not more than 6 percent of the roof area provided that daylight responsive controls complying with Section C405.2.3.1 are installed in toplit daylight zones.

C402.4.2 Minimum skylight fenestration area. In an enclosed space greater than 2,500 square feet (232 m²) in floor area, directly under a roof with not less than 75 percent of the ceiling area with a ceiling height greater than 15 feet (4572 mm), and used as an office, lobby, atrium, concourse, corridor, storage space, gymnasium/exercise center, convention center, automotive service area, space where manufacturing occurs, nonrefrigerated warehouse, retail store, distribution/sorting area, transportation depot or workshop, the total toplit daylight zone shall be not less than half the floor area and shall provide one of the following:

1. A minimum skylight area to toplit daylight zone of not less than 3 percent where all skylights have a VT of not less than 0.40 as determined in accordance with Section C303.1.3.
2. A minimum skylight effective aperture of not less than 1 percent, determined in accordance with Equation 4-4.

$$\text{Skylight Effective Aperture} = \frac{0.85 \times \text{Skylight Area} \times \text{Skylight VT} \times \text{WF}}{\text{Toplit Zone}}$$

(Equation 4-4)

where:

Skylight area = Total fenestration area of skylights.

Skylight VT = Area weighted average visible transmittance of skylights.

WF = Area weighted average well factor, where well factor is 0.9 if light well depth is less than 2 feet (610 mm), or 0.7 if light well depth is 2 feet (610 mm) or greater.

Light well depth = Measure vertically from the underside of the lowest point of the skylight glazing to the ceiling plane under the skylight.

Exception: Skylights above daylight zones of enclosed spaces are not required in:

1. Buildings in Climate Zones 6 through 8.
2. Spaces where the designed general lighting power densities are less than 0.5 W/ft² (5.4 W/m²).

3. Areas where it is documented that existing structures or natural objects block direct beam sunlight on not less than half of the roof over the enclosed area for more than 1,500 daytime hours per year between 8 a.m. and 4 p.m.
4. Spaces where the daylight zone under rooftop monitors is greater than 50 percent of the enclosed space floor area.
5. Spaces where the total area minus the area of ~~sidelit~~ ~~sidelit~~ daylight zones is less than 2,500 square feet (232 m²), and where the lighting is controlled in accordance with Section C405.2.3.

C402.4.4 Daylight zones. Daylight zones referenced in Sections C402.4.1.1 through C402.4.3.2 shall comply with Sections C405.2.3.2 and C405.2.3.3, as applicable. Daylight zones shall include toplit ~~daylight~~ zones and sidelit ~~daylight~~ zones.

C405.2.3 Daylight-responsive controls. Daylight-responsive controls complying with Section C405.2.3.1 shall be provided to control the electric lights within daylight zones in the following spaces:

1. Spaces with a total of more than 150 watts of ~~general~~ ~~general~~ lighting within sidelit ~~daylight~~ zones complying with Section C405.2.3.2 General lighting does not include lighting that is required to have specific application control in accordance with Section C405.2.4.
2. Spaces with a total of more than 150 watts of general lighting within toplit ~~daylight~~ zones complying with Section C405.2.3.3.

Exceptions: Daylight responsive controls are not required for the following:

1. Spaces in health care facilities where patient care is directly provided.
2. Lighting that is required to have specific application control in accordance with Section C405.2.4.
3. Sidelit ~~daylight~~ zones on the first floor above grade in Group A-2 and Group M occupancies.
4. New buildings where the total connected lighting power calculated in accordance with Section C405.3.1 is not greater than the adjusted interior lighting power allowance (LPA_{adj}) calculated in accordance with Equation 4-9

$$LPA_{adj} = \left[\frac{LPA_{norm}}{TBFA} \times (1.0 - 0.4 \times UDZFA) \right]$$

(Equation 4-9)

where:

LPA_{adj} = Adjusted building interior lighting power allowance in watts.

LPA_{norm} = Normal building lighting power allowance in watts calculated in accordance with Section C405.3.2 and reduced in accordance with Section C406.3 where Option 2 of Section C406.1 is used to comply with the requirements of Section C406.

UDZFA = Uncontrolled daylight zone floor area is the sum of all sidelit and toplit zones, calculated in accordance with Sections C405.2.3.2 and C405.2.3.3, that do not have daylight responsive controls.

TBFA = Total building floor area is the sum of all floor areas included in the lighting power allowance calculation in Section C405.3.2.

C405.2.3.1 Daylight-responsive control function. Where required, daylight-responsive controls shall be provided within each space for control of lights in that space and shall comply with all of the following:

1. Lights in toplit daylight zones in accordance with Section C405.2.3.3 shall be controlled independently of lights in sidelit daylight zones in accordance with Section C405.2.3.2.
2. Daylight responsive controls within each space shall be configured so that they can be calibrated from within that space by authorized personnel.
3. Calibration mechanisms shall be in a location with ready ~~access~~ access.
4. Where located in offices, classrooms, laboratories and library reading rooms, daylight responsive controls shall dim lights continuously from full light output to 15 percent of full light output or lower.
5. Daylight responsive controls shall be configured to completely shut off all controlled lights.
6. Lights in sidelit daylight zones in accordance with Section C405.2.3.2 facing different cardinal orientations [within 45 degrees (0.79 rad) of due north, east, south, west] shall be controlled independently of each other.

Exception: Up to 150 watts of lighting in each space is permitted to be controlled together with lighting in a daylight zone facing a different cardinal orientation.

C405.2.3.2 Sidelit daylight zone. The sidelit daylight zone is the floor area adjacent to vertical fenestration that complies with all of the following:

1. Where the fenestration is located in a wall, the sidelit daylight zone shall extend laterally to the nearest full-height wall, or up to 1.0 times the height from the floor to the top of the fenestration, and longitudinally from the edge of the fenestration to the nearest full-height wall, or up to 2 feet (610 mm), whichever is less, as indicated in Figure ~~C405.2.3.2~~ C405.2.3.2.
2. The area of the fenestration is not less than 24 square feet (2.23 m²).
3. The distance from the fenestration to any building or geological formation that would block access to daylight is greater than the height from the bottom of the fenestration to the top of the building or geologic formation.
4. The visible transmittance of the fenestration is not less than 0.20.

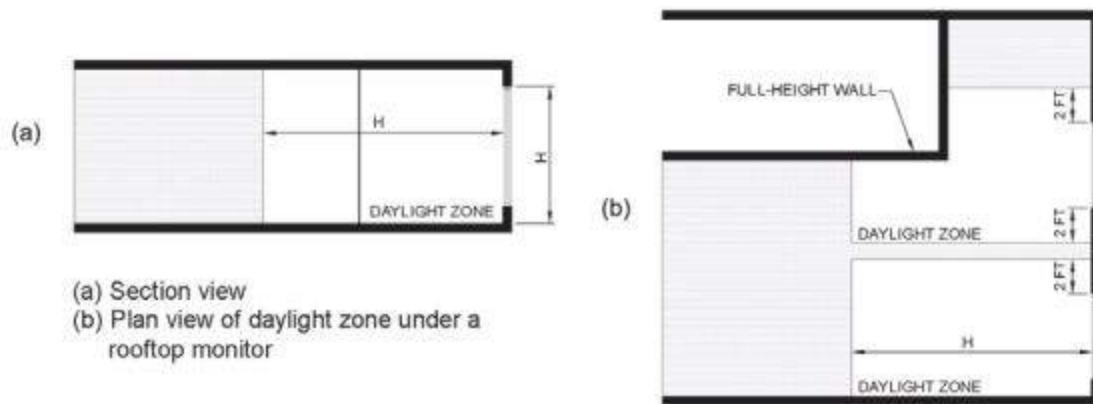


FIGURE C405.2.3.2
SIDELIT DAYLIGHT ZONE

C405.2.3.3 Toplit daylight zone. The toplit daylight zone is the floor area underneath a roof fenestration assembly that complies with all of the following:

1. The toplit daylight zone shall extend laterally and longitudinally beyond the edge of the roof fenestration assembly to the nearest obstruction that is taller than 0.7 times the ceiling height, or up to 0.7 times the ceiling height, whichever is less, as indicated in Figure C405.2.3.3(1).
2. Where the fenestration is located in a rooftop monitor, the toplit zone shall extend laterally to the nearest obstruction that is taller than 0.7 times the ceiling height, or up to 1.0 times the height from the floor to the bottom of the fenestration, whichever is less, and longitudinally from the edge of the fenestration to the nearest obstruction that is taller than 0.7 times the ceiling height, or up to 0.25 times the height from the floor to the bottom of the fenestration, whichever is less, as indicated in Figures C405.2.3.3(2) and C405.2.3.3(3).
3. Direct sunlight is not blocked from hitting the roof fenestration assembly at the peak solar angle on the summer solstice by buildings or geological formations.
4. The product of the visible transmittance of the roof fenestration assembly and the area of the rough opening of the roof fenestration assembly divided by the area of the toplit zone is not less than 0.008.

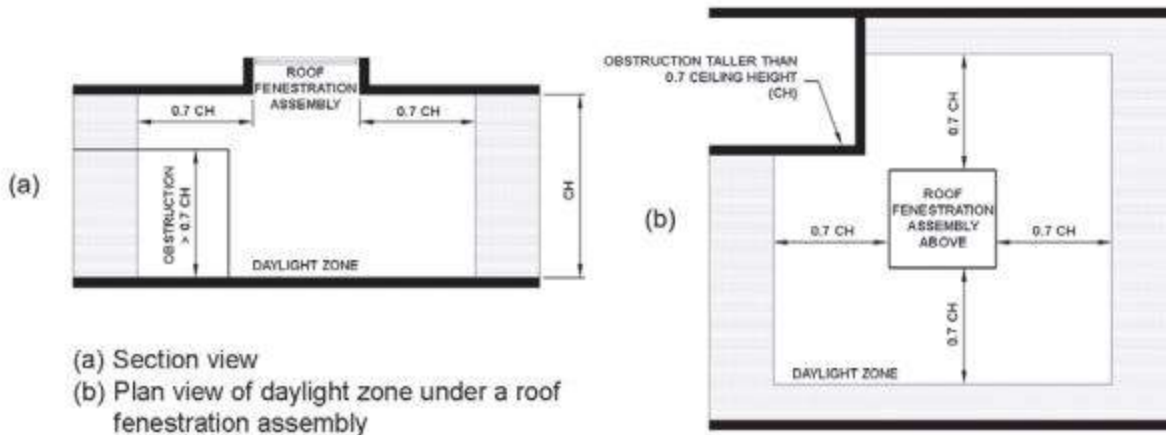


FIGURE C405.2.3.3(1)
TOPLIT DAYLIGHT ZONE

Reason: *Daylight zone* and *daylight responsive control* are defined terms.

Sidelit and toplit describe different types of *daylight zones*, but are not themselves defined terms and should not be italicized.

“Access” is a defined term, but is used in Section C405.2.3.2 for its’ common English meaning and should not be italicized.

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

Proposal # 4990

CE89-19

CE90-19

IECC: C402.4, C402.4.1.1, C402.4.1.2, C402.4.2.1

Proponent: Jack Bailey, representing International Association of Lighting Designers (jbailey@oneluxstudio.com); Glenn Heinmiller, Lam Partners, representing International Association of Lighting Designers (glenn@lampartners.com)

2018 International Energy Conservation Code

Revise as follows:

C402.4 Fenestration (Prescriptive). Fenestration shall comply with Sections C402.4.1 through C402.4.5 and Table C402.4. Daylight responsive controls shall comply with this section and Section ~~C405.2.3.1~~ C405.2.3.

C402.4.1.1 Increased vertical fenestration area with daylight responsive controls. In Climate Zones 1 through 6, not more than 40 percent of the gross above-grade wall area shall be vertical fenestration, provided that all of the following requirements are met:

1. In buildings not greater than two stories above grade, not less than 50 percent of the net floor area is within a daylight zone.
2. In buildings three or more stories above grade, not less than 25 percent of the net floor area is within a daylight zone.
3. Daylight responsive controls ~~complying with Section C405.2.3.1~~ are installed in daylight zones.
4. Visible transmittance (VT) of vertical fenestration is not less than 1.1 times solar heat gain coefficient (SHGC).

Exception: Fenestration that is outside the scope of NFRC 200 is not required to comply with Item 4.

C402.4.1.2 Increased skylight area with daylight responsive controls. The skylight area shall be not more than 6 percent of the roof area provided that daylight responsive controls ~~complying with Section C405.2.3.1~~ are installed in toplit zones.

C402.4.2.1 Lighting controls in toplit daylight zones. Daylight responsive controls ~~complying with Section C405.2.3.1~~ shall be provided to control all electric lights within ~~toplit zones~~ in toplit daylight zones.

Reason: These revisions correct the section reference number from C405.2.3.1 Daylight Responsive Controls Function to C405.2.3 Daylight responsive controls. This clarifies that the list of exceptions under C405.2.3 is applicable here.

Under C402.4.2.1 the phrase “to control all electric lights” is redundant when the section reference is updated from C405.2.3.1 to C405.2.3.

In general we have found these references to lighting controls requirements in the envelope section to be problematic in the past, where they seem to require that daylight responsive controls are required in applications which are exempt from daylight responsive controls in the lighting controls section.

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

Proposal # 4793

CE90-19

CE91-19

IECC: C402.4.1.2, C402.4.2

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

2018 International Energy Conservation Code

Revise as follows:

C402.4.1.2 Increased skylight area with daylight responsive controls. ~~The~~ Where daylight responsive controls complying with Section C405.2.3.1 are provided in toplit zones, the allowed skylight area shall be not more than 6 percent of the gross roof area provided that daylight responsive controls complying with Section C405.2.3.1 are installed in toplit zones or that required for compliance with Section C402.4.2, whichever is greater.

C402.4.2 Minimum skylight fenestration area. ~~In an enclosed space~~ Skylights shall be provided in enclosed spaces greater than 2,500 square feet (232 m²) in floor area, directly under a roof with not less than 75 percent of the ceiling area with a ceiling height greater than 15 feet (4572 mm), and used as an office, lobby, atrium, concourse, corridor, storage space, gymnasium/exercise center, convention center, automotive service area, space where manufacturing occurs, nonrefrigerated warehouse, retail store, distribution/sorting area, transportation depot or workshop, ~~the~~ The total toplit daylight zone shall be not less than half the floor area and shall provide comply with one of the following:

1. A minimum skylight area to toplit daylight zone of not less than 3 percent where all skylights have a VT of not less than 0.40 as determined in accordance with Section C303.1.3.
2. A minimum skylight effective aperture of not less than 1 percent, determined in accordance with Equation 4-4.

$$\text{Skylight Effective Aperture} = \frac{0.85 \times \text{Skylight Area} \times \text{Skylight VT} \times \text{WF}}{\text{Toplit Zone}}$$

(Equation 4-4)

where:

Skylight area = Total fenestration area of skylights.

Skylight VT = Area weighted average visible transmittance of skylights.

WF = Area weighted average well factor, where well factor is 0.9 if light well depth is less than 2 feet (610 mm), or 0.7 if light well depth is 2 feet (610 mm) or greater.

Light well depth = Measure vertically from the underside of the lowest point of the skylight glazing to the ceiling plane under the skylight.

Exception: Skylights above daylight zones of enclosed spaces are not required in:

1. Buildings in Climate Zones 6 through 8.
2. Spaces where the designed general lighting power densities are less than 0.5 W/ft² (5.4 W/m²).
3. Areas where it is documented that existing structures or natural objects block direct beam sunlight on not less than half of the roof over the enclosed area for more than 1,500 daytime

- hours per year between 8 a.m. and 4 p.m.
4. Spaces where the daylight zone under rooftop monitors is greater than 50 percent of the enclosed space floor area.
 5. Spaces where the total area minus the area of sidelight daylight zones is less than 2,500 square feet (232 m²), and where the lighting is controlled in accordance with Section C405.2.3.

Reason: In both sections being modified, the proposal provides clearer and more direct language for the user. In section C402.4.1.2 the 6% limit remains but also allows for compliance with the minimum skylight fenestration area in C402.4.2, whichever is greater. There is no substantive change in C402.4.2, changes are being offered for clarity only.

Cost Impact: The code change proposal will not increase or decrease the cost of construction. The intent of the proposal is to coordinate the provisions for maximum and minimum skylights and to provide clarity in the language for the user. The clarity may result in more or fewer skylights in certain designs, but should not affect the cost of construction.

Proposal # 4416

CE91-19

CE92-19

IECC: C402.4.2, Chapter 6CE (New)

Proponent: Marc Levitan, representing the ICC 500 Storm Shelter Development Committee; Benchmark Harris representing the National Storm Shelter Association (NSSA) (bharris@huckabee-inc.com)

2018 International Energy Conservation Code

Revise as follows:

C402.4.2 Minimum skylight fenestration area. In an enclosed space greater than 2,500 square feet (232 m²) in floor area, directly under a roof with not less than 75 percent of the ceiling area with a ceiling height greater than 15 feet (4572 mm), and used as an office, lobby, atrium, concourse, corridor, storage space, gymnasium/exercise center, convention center, automotive service area, space where manufacturing occurs, nonrefrigerated warehouse, retail store, distribution/sorting area, transportation depot or workshop, the total *toplit daylight zone* shall be not less than half the floor area and shall provide one of the following:

1. A minimum skylight area to *toplit daylight zone* of not less than 3 percent where all skylights have a VT of not less than 0.40 as determined in accordance with Section C303.1.3.
2. A minimum skylight effective aperture of not less than 1 percent, determined in accordance with Equation 4-4.

$$\text{Skylight Effective Aperture} = \frac{0.85 \times \text{Skylight Area} \times \text{Skylight VT} \times \text{WF}}{\text{Toplit Zone}}$$

(Equation 4-4)

where:

Skylight area = Total fenestration area of skylights.

Skylight VT = Area weighted average visible transmittance of skylights.

WF = Area weighted average well factor, where well factor is 0.9 if light well depth is less than 2 feet (610 mm), or 0.7 if light well depth is 2 feet (610 mm) or greater.

Light well depth = Measure vertically from the underside of the lowest point of the skylight glazing to the ceiling plane under the skylight.

Exception: Skylights above *daylight zones* of enclosed spaces are not required in:

1. Buildings in *Climate Zones* 6 through 8.
2. Spaces where the designed *general lighting* power densities are less than 0.5 W/ft² (5.4 W/m²).
3. Areas where it is documented that existing structures or natural objects block direct beam sunlight on not less than half of the roof over the enclosed area for more than 1,500 daytime hours per year between 8 a.m. and 4 p.m.
4. Spaces where the *daylight zone* under rooftop monitors is greater than 50 percent of the enclosed space floor area.
5. Spaces where the total area minus the area of sidelight *daylight zones* is less than 2,500 square feet (232 m²), and where the lighting is controlled in accordance with Section C405.2.3.
6. Spaces designed as storm shelters complying with ICC 500.



International Code Council, Inc.
500 New Jersey Avenue NW 6th
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Washington DC 20001

ICC 500: ICC/NSSA Standard for the Design and Construction of Storm Shelters

Reason: This proposal is submitted by the National Storm Shelter Association (NSSA) and the ICC 500 Storm Shelter Standard Development committee.

The ICC 500 Standards Development committee is responsible for the development of the ICC/NSSA Standard for the Design and Construction of Storm Shelters. The committee is currently working on the development of the 2020 edition. In 2017 the ICC 500 committee held 7 open conference calls. In addition, there were numerous Working Group meetings and conference calls, which included members of the committee as well as any interested party to discuss and debate the proposed changes. Related documentation and reports are posted on the BCAC website at: <https://www.iccsafe.org/codes-tech-support/codes/code-development-process/standards-development/is-stm>.

NSSA was responsible for the development of the original standard for storm shelters in 2001, which ICC 500 replaced through an agreement between ICC and NSSA. Representing General, User and Producer interest categories, NSSA is a technical organization that is committed to promoting consistent quality in both residential and community storm shelters.

A popular style of storm shelter for schools is to use a practice gymnasium as a multi-purpose building that also functions as a tornado shelter. C402.4.2 currently has minimum skylight fenestration requirements for “gymnasium/exercise center” spaces (and other types of spaces). This is generally good because there is value in having skylight fenestration in these spaces. However, the special case when a gymnasium is also used as a storm shelter warrants an exception to C402.4.2. There is an elevated life-safety concern associated with storm shelters and any skylights must meet strict missile impact testing and pressure requirements or be protected upon activation of the shelter with shutters. Building officials have requested this change to clarify that the intent of C402.4.2 was not to require skylights in storm shelters.

Cost Impact: The code change proposal will decrease the cost of construction
If skylights are not required, then the number of openings requiring protectives will be decreased.

Analysis: The referenced standard, ICC 500-2014, is currently referenced in other 2018 I-codes.

Proposal # 4849

CE92-19

CE93-19 Part I

PART I — IECC: Part I: C402.4.3, Chapter 6CE (New)\

IECC: Part II: R402.5(N1102.5), Chapter 6RE (IRC Chapter 44) (New)

PART II — IECC: R402.5 (IRC N1102.5), ICC Chapter 06

Proponent: Marc Levitan, representing the ICC 500 Storm Shelter Development Committee; Benchmark Harris representing the National Storm Shelter Association (NSSA) (bharris@huckabee-inc.com)

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

2018 International Energy Conservation Code

Revise as follows:

C402.4.3 Maximum *U*-factor and SHGC. The maximum *U*-factor and solar heat gain coefficient (SHGC) for fenestration shall be as specified in Table C402.4.

The window projection factor shall be determined in accordance with Equation 4-5.

$$PF = A/B$$

(Equation 4-5)

where:

PF = Projection factor (decimal).

A = Distance measured horizontally from the farthest continuous extremity of any overhang, eave or permanently attached shading device to the vertical surface of the glazing.

B = Distance measured vertically from the bottom of the glazing to the underside of the overhang, eave or permanently attached shading device.

Where different windows or glass doors have different *PF* values, they shall each be evaluated separately.

Exception: The maximum *U*-factor and solar heat gain coefficient (SHGC) for fenestration shall not be required in storm shelters complying with ICC 500.

Add new standard(s) as follows:

ICC

International Code Council, Inc.
500 New Jersey Avenue NW 6th
Floor
Washington DC 20001

ICC 500: ICC/NSSA Standard for the Design and Construction of Storm Shelters

Proposal # 4851

CE93-19 Part I

CE93-19 Part II

IECC: R402.5 (IRC N1102.5), ICC Chapter 06

Proponent: Benchmark Harris, representing National Storm Shelter Association (bharris@huckabee-inc.com)

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.

Exception: The maximum *U*-factor and solar heat gain coefficient (SHGC) for fenestration shall not be required in storm shelters complying with ICC 500.

Add new standard(s) as follows:

ICC

International Code Council, Inc.
500 New Jersey Avenue NW 6th
Floor
Washington DC 20001

ICC 500: ICC/NSSA Standard for the Design and Construction of Storm Shelters

Reason: This proposal is submitted by the National Storm Shelter Association (NSSA) and the ICC 500 Storm Shelter Standard Development committee.

The ICC 500 Standards Development committee is responsible for the development of the ICC/NSSA Standard for the Design and Construction of Storm Shelters. The committee is currently working on the development of the 2020 edition. In 2017 the ICC 500 committee held 7 open conference calls. In addition, there were numerous Working Group meetings and conference calls, which included members of the committee as well as any interested party to discuss and debate the proposed changes. Related documentation and reports are posted on the BCAC website at: <https://www.iccsafe.org/codes-tech-support/codes/code-development-process/standards-development/is-stm>.

NSSA was responsible for the development of the original standard for storm shelters in 2001, which ICC 500 replaced through an agreement between ICC and NSSA. Representing General, User and Producer interest categories, NSSA is a technical organization that is committed to promoting consistent quality in both residential and community storm shelters.

Storm windows have a limited availability with the *U* values required in Section R402.3 and R402.5. There is an elevated life-safety concern associated with storm shelters and any window must meet strict missile impact testing and pressure requirements or be protected upon activation of the shelter with shutters.

Cost Impact: The code change proposal will decrease the cost of construction
This modification will increase design options.

Analysis: The referenced standard, ICC 500-2014, is currently referenced in other 2018 I-codes.

Proposal # 5752

CE94-19

IECC C402.4.3.4(New); Chapter 6CE (New)

Proponent: Erika Burns, D+R International, representing Attachments Energy Rating Council (AERC)
(aerc316@gmail.com)

2018 International Energy Conservation Code

Add new text as follows:

C402.4.3.4 Automated Dynamic Shades Where interior or exterior shades, blinds, louvers, or drapes are used to improve the overall SHGC of the fenestration system, the combined performance calculated in accordance with Appendix B of AERC 1 and multiplied by 1.1 shall be permitted to satisfy the SHGC requirements found in Table C402.4 provided the shading device complies with all of the following:

1. The shading device is permanently attached.

2. The shading device is automatically controlled and capable of automatically modulating the amount of solar gain and light transmitted into the space in multiple steps in response to daylight levels or solar intensity.

3. The shading device is capable of providing not less than 90 percent coverage of the fenestration in the closed position.

4. Any manual control of the shading device shall not override automatic operation for longer than 4 hours per actuation.

AERC

Attachments Energy Rating
Council
355 Lexington Avenue
New York New York 10017
US

Add new standard(s) as follows:

AERC

Attachments Energy Rating
Council
355 Lexington Avenue
New York New York 10017
US

AERC 1-2018: Procedures for Determining Energy Performance Properties of Fenestration Attachments

Reason: Window and skylight shading systems can provide significant improvement in SHGC of fenestration systems. The only way to guarantee that these systems block solar heat gain when needed is through automatic control based on light or heat at the façade.

There already is an allowance for dynamic glazing (C402.4.3.3 Dynamic Glazing) to be allowed to help comply with SHGC. This proposal is similar but for permanent automated window shading devices. These automated shading devices are typically permanently attached to the interior or exterior of the wall or roof, are hardwired into the building and are as permanent as any luminaire.

The combined SHGC for the combination of the selected shading system with any window or skylight system is

readily available from the shading manufacturers or computed in free validated software such as WINDOW from Lawrence Berkeley National Laboratory.

There are industry standards that are used to measure the combined SHGC performance of windows with shading devices. Performance tests for Solar Heat Gain Coefficient SHGC (G-Value), Solar Transmittance (Ts), Solar Reflectance (Rs), Solar Absorptance (As), Visible Light Transmission VLT (Tv) can be conducted in accordance with EN 14501:2005, ASTM E891, and ASTM E903-96. Glass performance tests can be conducted using the Lawrence Berkeley National Laboratory Window NFRC certified software.

An example study showing how automated shading systems with high solar reflectance fabrics (example from Mermet : <http://www.mermetusa.com/transparent/t-screen-with-koolblack-3-5.html>) save significant cooling energy can be found at: <http://performanceshadingadvisor.com/#thermalmanagement>

In addition to solar heat gain improvement, this technology inherently saves other energy. When the shade is open, there will be more savings on the electric lighting side due to daylight dimming. Automation closes the shade when there is glare or increased solar energy, but opens the shade to allow more natural light when glare or solar heat gain is not a problem.

Cost Impact: The code change proposal will not increase or decrease the cost of construction. This proposal does not require use of dynamic shading; it just allows combined SHGC to be used if a project is already using dynamic shades.

Analysis: A review of the standard proposed for inclusion in the code, AERC 1, 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.

Proposal # 4991

CE94-19

CE95-19

IECC: C403.2.2

Proponent: Kevin Duerr-Clark, NYS Department of State, representing NYS Department of State (kevin.duerr-clark@dos.ny.gov); Joseph Hill, representing NYSDOS (joseph.hill@dos.ny.gov)

2018 International Energy Conservation Code

Revise as follows:

C403.2.2 Ventilation (Mandatory). Ventilation, either natural or mechanical, shall be provided in accordance with the commercial building provisions of Chapter 4 of the International Mechanical Code. Where mechanical ventilation is provided, the system shall provide the capability to reduce the outdoor air supply to the minimum required by Chapter 4 of the International Mechanical Code.

Reason: Section C403.2.2 "Ventilation" of the Energy Code references Chapter 4 of the Mechanical Code. However, Section 401.2 of the Mechanical Code includes a cross reference to a residential provision of the Energy Code: R402.4.1.2 pertaining to dwelling units. This may inadvertently and erroneously lead code users to believe that dwelling units in a commercial building, such as a multi-family building more than three stories in height, can be regulated by the residential provisions of the Energy Code.

Cost Impact: The code change proposal will not increase or decrease the cost of construction. This proposal is simply a clarification of an existing code provision and does not carry a cost implication.

Proposal # 4483

CE95-19

CE96-19

IECC: C202 (New), C402.5, C402.5.1, C402.5.1.2, C402.5.1.2.3 (New)

Proponent: Gayathri Vijayakumar, representing Steven Winter Associates, Inc. (gayathri@swinter.com); Robert Schwarz, representing EnergyLogic (robby@nrglogic.com)

2018 International Energy Conservation Code

SECTION C202 GENERAL DEFINITIONS

Add new definition as follows:

TESTING UNIT ENCLOSURE AREA. The area sum of all the boundary surfaces that define the *dwelling unit, sleeping unit, or occupiable conditioned space* including top/ceiling, bottom/floor, and all side walls. This does not include interior partition walls within the *dwelling unit, sleeping unit, or occupiable conditioned space*. Wall height shall be measured from the finished floor of the *conditioned space* to the finished floor or roof/ceiling air barrier above.

Revise as follows:

C402.5 Air leakage—thermal envelope (Mandatory). The building thermal envelope ~~of buildings~~ shall comply with Sections C402.5.1 through C402.5.8, or the building thermal envelope shall be tested in accordance with ASTM E 779 at a pressure differential of 0.3 inch water gauge (75 Pa) or an equivalent method approved by the code official and deemed to comply with the provisions of this section when the tested air leakage rate of the building thermal envelope is not greater than 0.40 cfm/ft² (2.0 L/s • m²). Where compliance is based on such testing, the building shall also comply with Sections C402.5.5, C402.5.6 and C402.5.7.

C402.5.1 Air barriers. A continuous air barrier shall be provided throughout the building thermal envelope. The continuous air barriers shall be ~~permitted to be~~ located on the inside or outside of the building thermal envelope, located within the assemblies composing the building thermal envelope, or any combination thereof. The air barrier shall comply with Sections C402.5.1.1 and C402.5.1.2.

Exception: Air barriers are not required in buildings located in Climate Zone 2B.

C402.5.1.1 Air barrier construction. The continuous air barrier shall be constructed to comply with the following:

1. The air barrier shall be continuous for all assemblies that are the thermal envelope of the building and across the joints and assemblies.
2. Air barrier joints and seams shall be sealed, including sealing transitions in places and changes in materials. The joints and seals shall be securely installed in or on the joint for its entire length so as not to dislodge, loosen or otherwise impair its ability to resist positive and negative pressure from wind, stack effect and mechanical ventilation.
3. 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, contraction and mechanical vibration. Joints and seams associated with penetrations shall be sealed in the same manner or taped. Sealing materials shall be securely installed around the penetration so as not to dislodge, loosen or otherwise impair the penetrations' ability to resist positive and negative pressure from wind, stack effect and mechanical ventilation. Sealing of concealed fire sprinklers, where required, shall be 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.

4. Recessed lighting fixtures shall comply with Section C402.5.8. Where similar objects are installed that penetrate the air barrier, provisions shall be made to maintain the integrity of the air barrier.

C402.5.1.2 Air barrier compliance options. A continuous air barrier for the opaque building envelope shall comply with the following:

1. Buildings or portions of buildings including Group R and Group I occupancy shall meet the provisions of Section C402.5.1.2.3.
Exception: Buildings in Climate Zones 2B, 3C, and 5C.
2. Buildings or portions of buildings including Group R and Group I occupancy in Climate Zones 3C and 5C shall meet the provisions of Section C402.5.1.2.1 or C402.5.1.2.2.
3. Buildings or portions of buildings other than Group R and Group I occupancy shall meet the provisions of Section C402.5.1.2.1 or C402.5.1.2.2.

C402.5.1.2.1 Materials. Materials with an air permeability not greater than 0.004 cfm/ft² (0.02 L/s • m²) under a pressure differential of 0.3 inch water gauge (75 Pa) when tested in accordance with ASTM E2178 shall comply with this section. Materials in Items 1 through 16 shall be deemed to comply with this section, provided that joints are sealed and materials are installed as air barriers in accordance with the manufacturer's instructions.

1. Plywood with a thickness of not less than $\frac{3}{8}$ inch (10 mm).
2. Oriented strand board having a thickness of not less than $\frac{3}{8}$ inch (10 mm).
3. Extruded polystyrene insulation board having a thickness of not less than $\frac{1}{2}$ inch (12.7 mm).
4. Foil-back polyisocyanurate insulation board having a thickness of not less than $\frac{1}{2}$ inch (12.7 mm).
5. Closed-cell spray foam having a minimum density of 1.5 pcf (2.4 kg/m³) and having a thickness of not less than $1\frac{1}{2}$ inches (38 mm).
6. Open-cell spray foam with a density between 0.4 and 1.5 pcf (0.6 and 2.4 kg/m³) and having a thickness of not less than 4.5 inches (113 mm).
7. Exterior or interior gypsum board having a thickness of not less than $\frac{1}{2}$ inch (12.7 mm).
8. Cement board having a thickness of not less than $\frac{1}{2}$ inch (12.7 mm).
9. Built-up roofing membrane.
10. Modified bituminous roof membrane.
11. Fully adhered single-ply roof membrane.
12. A Portland cement/sand parge, or gypsum plaster having a thickness of not less than $\frac{5}{8}$ inch (15.9 mm).
13. Cast-in-place and precast concrete.
14. Fully grouted concrete block masonry.
15. Sheet steel or aluminum.
16. Solid or hollow masonry constructed of clay or shale masonry units.

C402.5.1.2.2 Assemblies. Assemblies of materials and components with an average air leakage not greater than 0.04 cfm/ft² (0.2 L/s • m²) under a pressure differential of 0.3 inch of water gauge (w.g.)(75 Pa) when tested in accordance with ASTM E2357, ASTM E1677 or ASTM E283 shall comply with this section. Assemblies listed in Items 1 through 3 shall be deemed to comply, provided that joints are sealed and the requirements of Section C402.5.1.1 are met.

1. Concrete masonry walls coated with either one application of block filler or two applications of a

- paint or sealer coating.
- 2. Masonry walls constructed of clay or shale masonry units with a nominal width of 4 inches (102 mm) or more.
- 3. A Portland cement/sand parge, stucco or plaster not less than $\frac{1}{2}$ inch (12.7 mm) in thickness.

Add new text as follows:

C402.5.1.2.3 Dwelling and sleeping unit enclosure testing The building thermal envelope shall be tested in accordance with ASTM E 779, ANSI/RESNET/ICC 380, ASTM E1827 or an equivalent method approved by the code official. The measured air leakage shall not exceed 0.30 cfm/ft^2 ($1.5 \text{ L/s} \cdot \text{m}^2$) of the testing unit enclosure area at a pressure differential of 0.2 inch water gauge (50 Pa). Where multiple dwelling units or sleeping units or other occupiable conditioned spaces are contained within one building thermal envelope, each unit shall be considered an individual testing unit and the building air leakage shall be the weighted average of all testing unit results, weighted by each testing unit's testing unit enclosure area. Units shall be tested separately with an unguarded blower door test as follows:

1. Where buildings have fewer than eight testing units, each testing unit shall be tested.
2. For buildings with eight or more testing units the greater of seven units or 20 percent of the testing units in the building shall be tested including a top floor unit, a ground floor unit, and a unit with the largest testing unit enclosure area. Where any tested unit exceeds the maximum air leakage rate, an additional 20 percent of units shall be tested, including a mixture of testing unit types and locations.

Reason: Air leakage can be a significant source of energy waste in buildings, contributing to higher heating and cooling costs for building owners and occupants, and increasing risk related to comfort and durability. Air tightness testing can result in more attention to air barrier sealing and significantly reduced building leakage. Currently, the residential energy code requires air tightness testing for residential buildings three stories and less in height to ensure proper tightness and a controlled indoor environment. However, in the commercial energy code there is no testing requirement for residential buildings four stories or more in height (e.g., apartments, dormitories, hotel guest rooms). Industry standards affecting these buildings have historically relied upon visual verification, as well as material and assembly requirements. Providing adequate control over air leakage can also allow many benefits, including reduced HVAC equipment sizing, better building pressurization, and energy savings due to reduced heating and cooling of infiltrated outside air. In moist climates, ensuring lower leakage through testing can also result in better humidity control and reduced risk of durability issues. Air barrier testing saves energy by reducing infiltration of outside air into and out of the building. Most of the time, outside air is hotter or colder than the comfort temperature being maintained in the residence by the heating and cooling systems. Therefore, reducing the infiltration will reduce energy use for heating and cooling. This proposal would require that blower door testing be applied to a sample of units or occupiable spaces in a multiple unit residential construction project. The equipment and staff required are the same as are needed in current air leakage testing required under the residential energy code.

Why is building leakage testing superior to other approaches?

While it is important that the materials and assemblies have limited leakage, specification by individual materials and assemblies does not necessarily equate to an air-tight building. Recent research (Wiss 2014) shows that 40% of buildings constructed without an envelope consultant have air leakage exceeding the current optional test standard of 0.40 cfm/ft^2 at 75 Pa, while buildings with envelope consultants had leakage below 0.25 cfm/ft^2 at 75 Pa. Requiring testing will ensure that the goal of this section of the code—limiting unintended air infiltration in buildings—is achieved.

What strategies are considered to minimize compliance burdens in the field?

To manage testing cost, a testing approach is proposed that requires only 20% of the units (with a seven-unit

minimum) to be tested in the building. The testing method is also an unguarded test of individual units that reduces cost significantly compared to whole building testing or guarded unit testing. To motivate high-quality air sealing, additional testing of an additional 20% of the units would be required if any unit exceeds the leakage limit. Then the weighted average of tested units is used for comparison to the required leakage limit. While the testing requirement is slightly less stringent than the residential code, it matches current optional commercial requirements and is an improvement over the current condition of no testing requirements in the commercial code. It also provides a more reasonable target than air changes per hour for these units, which are typically smaller and have less total leakage than detached residences.

Are there existing codes and standards that require similar testing measures?

This proposal is similar to the residential air leakage provisions in the 2018 IECC in that it also requires the use of ASTM E 779. The proposal is similar to air leakage testing that is required by the State of Washington and City of Seattle commercial building energy codes as well as procedures followed by the U.S. Department of Defense for testing of commercial buildings. The City of Seattle requirements have been in place since 2009 and hundreds of commercial buildings have been tested under that code, including many large buildings. Additionally, thousands of dwelling units have successfully been tested and achieved this metric through the USGBC's LEED for Homes Multifamily Mid-Rise program and the EPA's ENERGY STAR Multifamily High Rise program. It will also be a required test in ASHRAE 62.2-2019.

Bibliography: Hart R and B Liu. 2015. *Methodology for Evaluating Cost-effectiveness of Commercial Energy Code Changes*. Pacific Northwest National Laboratory for U.S. Department of Energy; Energy Efficiency & Renewable Energy. PNNL-23923, Rev. 1. <https://www.energycodes.gov/development/commercial/methodology>
Hart R and M Tyler. 2018. *Envelope Air Tightness for Sleeping and Dwelling Units*. Pacific Northwest National Laboratory for U.S. Department of Energy. PNNL-28337.
http://www.pnnl.gov/main/publications/external/technical_reports/PNNL-28337.pdf

Wiss J. 2014. *ASHRAE 1478-RP Measuring Airtightness of Mid- and High-Rise Non-Residential Buildings*. Elstner Associates, Inc. for ASHRAE. <https://web.ornl.gov/sci/buildings/conf-archive/2013%20B12%20papers/186-Brennan.pdf>

Cost Impact: The code change proposal will increase the cost of construction
PNNL performed a cost-effectiveness analysis to identify the net impacts associated with the proposal using the established DOE methodology (Hart and Liu 2015). Results of the cost-effectiveness analysis indicate that the average savings-to-investment ratio (SIR) and simple payback (SPP) for unguarded dwelling unit testing with a limit of 0.30 cfm/ft² (1.5 L/s · m²) at a pressure differential of 0.2 inch water gauge (50 Pa) in mid-rise apartment buildings were:

- SIR: 7.8; cost-effective if greater than 1.0
- SPP: 5.3 years; cost-effective if less than 40 year life

A measure is cost-effective when the SIR is greater than 1.0, indicating that the present value of savings is greater than the incremental cost. The cost for individual unguarded unit testing is expected to be significantly lower than the cost for whole building testing, especially with the sampling protocol provided. Results of the cost-effectiveness analysis were taken into account when developing this proposal (i.e., the recommended language only targets building types and climate zones where the testing requirement was determined to be cost-effective).

For buildings already conducting whole-building testing as their compliance option, this may decrease the cost of construction. For buildings not conducting testing, this is an increase in costs to perform the tests. This

proposal however does not require more than what is currently required in the residential IECC for similar types of commercial buildings 3 stories and lower.

Proposal # 4873

CE96-19

CE97-19

IECC: C402.5, C402.5.1, C402.5.1.2, **C402.5.1.2.3 (New)**

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

2018 International Energy Conservation Code

Revise as follows:

C402.5 Air leakage—thermal envelope (Mandatory). ~~The building thermal envelope of buildings shall comply with Sections C402.5.1 through C402.5.8, or the building thermal envelope shall be tested in accordance with ASTM E 779 at a pressure differential of 0.3 inch water gauge (75 Pa) or an equivalent method approved by the code official and deemed to comply with the provisions of this section when the tested air leakage rate of the building thermal envelope is not greater than 0.40 cfm/ft² (2.0 L/s · m²).~~ with Section C402.5.1.2.3. Where compliance is based on such testing, the building shall also comply with Sections C402.5.5, C402.5.6 and C402.5.7.

C402.5.1 Air barriers. A continuous air barrier shall be provided throughout the building thermal envelope. The air barriers shall be ~~permitted to be~~ located on the inside or outside of the building ~~thermal~~ envelope, located within the assemblies composing the ~~building thermal~~ envelope, or any combination thereof. The air barrier shall comply with Sections C402.5.1.1 and C402.5.1.2.

Exception: Air barriers are not required in buildings located in Climate Zone 2B.

C402.5.1.2 Air barrier ~~compliance options:~~ compliance. A continuous air barrier for the opaque building envelope shall comply with ~~the following:~~

1. ~~Buildings or portions of buildings including group R and group I occupancy shall meet the provisions of Section C402.5.1.2.1 or C402.5.1.2.2.~~
2. ~~Buildings or portions of buildings of other than group R and group I occupancy shall meet the provisions of Section C402.5.1.2.3.~~

Exceptions:

1. Buildings in Climate Zones 2B, 3B, 3C, and 5C.
 2. Buildings larger than 5000 square feet floor area in Climate Zones 0B, 1, 2A, 4B, and 4C.
 3. Buildings between 5000 and 50,000 square feet floor area in Climate Zones 0A, 3A and 5B.
3. Buildings or portions of buildings other than group R and group 1 occupancy that do not complete air barrier testing shall meet the provisions of Section C402.5.1.2.1 or C402.5.1.2.2.

Add new text as follows:

C402.5.1.2.3 Non-residential building thermal envelope testing The building thermal envelope shall be tested in accordance with ASTM E 779 or an equivalent method approved by the code official. The measured air leakage shall not exceed 0.40 cfm/ft² (2.0 L/s · m²) of the building thermal envelope area at a pressure differential of 0.3 inch water gauge (75 Pa). Alternatively, portions of the building shall be tested and the measured air leakages shall be area-weighted by the surface areas of the building envelope in each portion. The weighted average test results shall not exceed the whole building leakage limit. In the alternative approach, the following portions of the building shall be tested:

1. The entire envelope area of all stories that have any spaces directly under a roof,
2. The entire envelope area of all stories that have a building entrance, exposed floor, or loading dock, or are below grade, and
3. Representative above-grade sections of the building totaling at least 25 percent of the wall area enclosing the remaining conditioned space.

Exception: Where the measured air leakage rate exceeds 0.40 cfm/ft² (2.0 L/s•m²) but does not exceed 0.60 cfm/ft² (3.0 L/s•m²), a diagnostic evaluation using smoke tracer or infra-red imaging shall be conducted while the building is pressurized along with a visual inspection of the air barrier. Any leaks noted shall be sealed where such sealing can be made without destruction of existing building components. An additional report identifying the corrective actions taken to seal leaks shall be submitted to the code official and the building owner, and shall be deemed to comply with satisfy the requirements of this section.

Reason: Air leakage can be a significant source of energy waste in buildings, contributing to higher heating and cooling costs for building owners and occupants, and increasing risk related to comfort and durability. Air tightness testing can result in more attention to envelope assembly air barrier sealing and significantly reduced building leakage. Currently Section C402.5 Air Leakage – thermal envelope, allows air tightness testing as an alternative to meeting material or assembly selection and installation method requirements to ensure proper tightness and a controlled indoor environment. Adequate control over air leakage can provide many benefits, including reduced HVAC equipment sizing, better building pressurization, and energy savings due to reduced heating and cooling of infiltrated outside air. In moist climates, ensuring lower air leakage through whole-building testing can also result in better humidity control and reduced risk of durability issues.

While it is important that the materials and assemblies have limited leakage, that alone does not guarantee a low leakage building. Recent research (Wiss 2014) shows that 40% of buildings constructed *without* an envelope consultant have air leakage exceeding the currently optional test standard requirements, while buildings with envelope consultants all had leakage below 0.25 cfm/ft². Testing is the most reliable means of ensuring that the intent of this code section—limiting unintended energy waste in buildings due to air infiltration—will be achieved.

The measure retains the current IECC optional compliance path test limit of 0.40 cfm/ft² at 75 Pa. Since mandatory—rather than optional—testing would be a new requirement, it is appropriate to retain the current and higher limit of 0.4 cfm/ft² for improved building industry acceptance. Durston and Heron’s review (2012) of the more stringent requirements by the U.S. Department of Defense (DOD) shows that without testing, the range of building leakage can exceed the requirement by more than double (0.9 cfm/ft²). However, with testing included as part of the construction process, the average leakage of buildings was determined to be well below the 0.4 cfm/ft² limit. Therefore, based on the DOD findings, the test limit of 0.40 cfm/ft² is considered a realistic and achievable goal. In addition, the target is well established in the IECC, and aligns with similar optional requirements contained in Standard 90.1.

Intent of the Code Change Proposal

This code change proposal will require

- The leakage testing thresholds are the same as current optional testing thresholds.
- Proposed requirements for testing vary by climate zone and building size and are based on industry-accepted cost-effectiveness analysis methods.
- As outlined in the optional compliance path, portions of buildings could be tested on a sampling basis.
- Commercial buildings under 5000 square feet can be tested using residential methods, technicians, and

equipment with the maximum leakage rate set at 0.30 cfm/ft² (1.5 L/s · m²) at 0.2 in. w.g. (50 Pa). This testing pressure differential is common for residential testing, and is equivalent to a leakage rate of 0.40 cfm/ft² (1.5 L/s · m²) at 0.3 in. w.g. (75 Pa), the current alternative commercial test limit. Yet, implementing the residential procedure can dramatically reduce testing costs for these smaller buildings.

- Since this would be a new requirement, a backup exception is provided so that if a building fails the 0.40 cfm/ft² test, the building can still pass the requirement as long as the tested value is below 0.60 cfm/ft² and additional diagnostics are performed.

Climate Zones 0A and 0B are included in the code change proposal assuming that a code change proposal submitted by SEHPCAC to update the climate zones is submitted and approved. These climate zone designations can be removed from the proposal with no impact if the climate zones are not updated.

What strategies are considered to minimize compliance burdens in the field?

Three specific strategies are applied to minimize the impact of testing on building project costs:

- Testing is only required for certain building types and climate zones where analysis indicates it is cost-effective and the savings justifies the cost. Based on that analysis, size thresholds by climate zone are provided for non-residential buildings.
- It is also prudent to provide some flexibility in the test standard to allow for building industry acceptance and a transition to meeting a fixed testing requirement. Specifically, when the building envelope is complete and testing occurs, access to the air barrier for repairs is difficult. Thus, an exception is included that allows the tested leakage rate to be no more than 0.6 cfm/ft² as long as specific remediation efforts are made. This exception is meant to provide a modest relaxation of the requirement, but only if significant corrective actions are taken that may reduce the air leakage.
- As an additional strategy, the measure allows representative portions or a sample of spaces in the building to be tested instead of the whole building. This alternative supports more economical testing of large buildings, which can help reduce the compliance burden and is consistent with similar requirements in ASHRAE 90.1-2016.

Existing Codes and Standards that Require Similar Testing Measures

The measure is consistent with air leakage testing requirements and thresholds required by the State of Washington and City of Seattle commercial building energy codes (SDCI Community Engagement 2012), as well as procedures followed by the DOD for testing of commercial buildings referenced above. The City of Seattle requirements have been in place since 2009, and hundreds of commercial buildings have been tested under that code, including many large buildings. The proposed measure is less stringent than the current DOD requirements (0.25 cfm/ft²), and case studies (Durstun and Heron 2012) have shown that much lower leakage levels—in the range of 0.15 cfm/ft²—can be achieved.

Energy Savings

An analysis of energy impact shows that annual energy savings from air barrier improvement resulting from testing due to the measure ranges from \$5.07 to \$71.88 per thousand square feet of floor area in offices in climate zones where testing is recommended. More details are found in the cost-effectiveness analysis referenced in the Appendix.

Cost-effectiveness: Pacific Northwest National Laboratory performed a cost-effectiveness analysis using the established DOE methodology (Hart and Liu 2015). Results of the analysis indicate that the average savings-to-investment ratio (SIR) and simple payback period (SPP) for commercial building testing with a limit of 0.40 cfm/ft² (1.5 L/s · m²) at a pressure differential of 0.3 inch w.g. (50 Pa) in office buildings vary by size, as shown in the table below.

Building size range, floor area square feet	<5000	5000 to 50,000	>50,000
Average SIR	7.3	2.2	3.2
Average SPP (years)	7.1	13.1	10.2

A measure is cost-effective when the SIR is greater than 1.0, indicating that the present value of savings is greater than the incremental cost. Under ASHRAE 90.1 criteria, cost-effectiveness is proven when the simple payback is shorter than the scalar threshold of 22.2 years. Based on the cost-effectiveness analysis results, air barrier testing is specified for buildings that have both an SIR greater than 1 and a simple payback that is less than the 90.1 scalar threshold based on climate zone and building size.

As a result of breaks in cost assumptions, most climate zones qualify for testing for buildings below 5000 square feet, with fewer climate zones requiring testing for buildings larger than 50,000 square feet, and the fewest climate zones requiring testing for buildings between 5000 and 50,000 square feet.

Bibliography: TechBrief-ComBldgAirLeakageTesting_PNNL-28367

https://www.pnnl.gov/main/publications/external/technical_reports/PNNL-28367.pdf

Wiss J. 2014. *ASHRAE 1478-RP Measuring Airtightness of Mid- and High-Rise Non-Residential Buildings*. Elstner Associates, Inc. for ASHRAE. <https://www.ashrae.org/resources--publications/periodicals/enewsletters/esociety/2014-12-10-articles/completed-research-december-2014>.

Durston JL and M Heron. 2012. *Summary and Analysis of Large Building Air Leakage Testing for the U.S. Department of Defense*. Atlanta, GA. http://c.ymcdn.com/sites/www.nibs.org/resource/resmgr/BEST/best3_durston.2.9.pdf.

Hart R and B Liu. 2015. *Methodology for Evaluating Cost-effectiveness of Commercial Energy Code Changes*. Pacific Northwest National Laboratory for U.S. Department of Energy; Energy Efficiency & Renewable Energy. PNNL-23923, Rev. 1. <https://www.energycodes.gov/development/commercial/methodology>.

SDCI Community Engagement. 2012. "Air Barriers and Pressure Testing." *Building Connections*, March 12, 2012. <http://buildingconnections.seattle.gov/2012/03/01/air-barriers-and-pressure-testing/>.

Background References

NEEC. 2011. *Air Barrier Management Fact Sheet*. <https://nec.net/wp-content/uploads/2009/04/NREC-Air-Barrier-07-2011.pdf>.

Air Barrier Association of America. 2018. *ABAA Energy Savings Calculator*. <http://www.airbarrier.org/technical-information/energy-savings-calculator/>.

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

This measure will increase the cost of construction of new commercial buildings as whole building air leakage testing will be required except for primarily residential buildings (Group R and I building occupancies). Based on a survey of professional commercial building air barrier testing companies, it was determined that the cost of air

leakage testing fell into three ranges:

- \$350 or \$0.12 to \$0.07 per square foot for buildings up to 5000 square feet
- \$0.50 to \$0.15 per square foot for buildings between 5000 and 50,000 square feet
- \$0.15 to \$0.09 per square foot for buildings between 50,000 and 100,000 square feet, with decreasing costs for larger buildings.

As demand for air leakage testing in commercial buildings increases, more companies will enter the market to provide these services. Therefore, a gradual decrease in cost is expected as more companies are available to do the testing.

Proposal # 5146

CE97-19

CE98-19

IECC: C402.5, Chapter 6CE (New)

Proponent: Theresa Weston, representing Air Barrier Association of America (ABAA)
(theresa.a.weston@dupont.com)

2018 International Energy Conservation Code

Revise as follows:

C402.5 Air leakage—thermal envelope (Mandatory). The *thermal envelope* of buildings shall comply with Sections C402.5.1 through C402.5.8, or the building *thermal envelope* shall be tested in accordance with ASTM E779 at a pressure differential of 0.3 inch water gauge (75 Pa), ASTM E3158 or an equivalent method approved by the code official and deemed to comply with the provisions of this section when the tested air leakage rate of the building thermal envelope is not greater than 0.40 cfm/ft² (2.0 L/s • m²). Where compliance is based on such testing, the building shall also comply with Sections C402.5.5, C402.5.6 and C402.5.7.

Add new standard(s) as follows:

ASTM

ASTM International
100 Barr Harbor Drive, P.O. Box
C700
West Conshohocken, PA 19428-
2959

ASTM E3158-18: Test Method for Measuring the Air Leakage Rate of a Large or Multizone Building

Reason: This proposal adds an option for the test method used to test a building's air leakage. The method was developed with significant input for industry testing professionals and will be especially beneficial for large and multi-zone buildings.

Cost Impact: The code change proposal will not increase or decrease the cost of construction
No cost effect as it does not change requirements only provides more options to the testing details.

Analysis: A review of the standard proposed for inclusion in the code, ASTM E3158, 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.

Proposal # 4953

CE98-19

CE99-19

IECC: C103.2, C402.5.1, C402.5.1.3 (New)

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

2018 International Energy Conservation Code

Revise as follows:

C103.2 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, but are not limited to, the following as applicable:

1. Insulation materials and their *R*-values.
2. Fenestration *U*-factors and solar heat gain coefficients (SHGCs).
3. Area-weighted *U*-factor and solar heat gain coefficient (SHGC) calculations.
4. Mechanical system design criteria.
5. Mechanical and service water heating systems and equipment types, sizes and efficiencies.
6. Economizer description.
7. Equipment and system controls.
8. Fan motor horsepower (hp) and controls.
9. Duct sealing, duct and pipe insulation and location.
10. Lighting fixture schedule with wattage and control narrative.
11. Location of *daylight* zones on floor plans.
12. Air ~~sealing details~~ barrier and air sealing details, including the location of the air barrier.

C402.5.1 Air barriers. A continuous air barrier shall be provided throughout the building thermal envelope. The air barriers shall be permitted to be located on the inside or outside of the building envelope, located within the assemblies composing the envelope, or any combination thereof. The air barrier shall comply with Sections C402.5.1.1, C402.5.1.2 and ~~C402.5.1.2~~, C402.5.1.3.

Exception: Air barriers are not required in buildings located in *Climate Zone 2B*.

Add new text as follows:

C402.5.1.3 Building envelope performance verification. The installation of the continuous air barrier shall be verified by a registered design professional or approved agency in accordance with the following:

1. A review of the construction documents and other supporting data shall be conducted to assess compliance with the requirements in Sections C402.5.1.
2. Inspection of continuous air barrier components and assemblies shall be conducted during construction while the air barrier is still accessible for inspection and repair to verify compliance with the requirements of Sections C402.5.1.1 and C402.5.1.
3. A final commissioning report shall be completed by the registered design professional or approved agency and provided to the building owner or owner's authorized agent and the code official. The report shall identify deficiencies found during the review of the construction documents and inspection and details of corrective measures used.

Reason: The testing path for infiltration in the IECC requires a leakage rate of 0.40 CFM/sf @ 75PA. However, according to "Achieving the 30% Goal: Energy and Cost Savings Analysis of ASHRAE Standard 90.1-2010"

prepared by the Pacific Northwest National Lab, the prescriptive air barrier requirements currently used in the IECC only achieve 1.0 CFM/sf @ 75Pa. The prescriptive path is therefore not achieving the level of performance achieved by the testing path. The code requires that air barrier materials meet 0.40 CFM/sf @ 75Pa, so the issue must be with installation and not the materials themselves. This proposal narrows that gap by requiring verification of the air barrier during construction and reporting back to the owner and code official in a manner similar to existing acceptance testing requirements, thereby ensuring better air barrier installation without actually requiring testing.

The proposal includes a sequence of requirements to ensure both effectiveness, ease of implementation and ease of enforcement. Key among these is a requirement that the inspection occur while remediation of errors can still be remedied. Submission of the report to the code official and the owner will ensure that the process has been followed.

The proposal also modifies the charging language in C402.5 and the construction documentation requirements in C103 to enable the new requirements.

According to Evan Mills, PhD, a researcher at Lawrence Berkeley National Laboratory, savings associated with using BECx from both maintenance and energy savings average about 16% for existing buildings and 13% for new construction ("Calculating the ROI of building enclosure commissioning." *Building Design + Construction*. June 28, 2013.)

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

Evan Mills, PhD, a researcher at Lawrence Berkeley National Laboratory studied the benefits of BECx, noting that commissioning only costs about \$1.16/sf for new construction and \$0.30/sf for existing buildings on average, with a payback period of as little as 14 months.

Proposal # 5158

CE99-19

CE100-19

IECC: C402.5.1.2

Proponent: Laverne Dalglish, Building Professionals, representing Air Barrier Association of America
(ldalglish@airbarrier.org)

2018 International Energy Conservation Code

Revise as follows:

C402.5.1.2 Air barrier compliance options. A continuous air barrier for the opaque building envelope shall comply with Section C402.5.1.2.1 ~~or~~ and C402.5.1.2.2.

Reason: The option of simply conducting a air leakage rate test on a one square meter (approximately 39 inches square) of material does not mean that using the material in a building will result in a building that does not have excessive air leakage. The material needs to be put together into an air barrier assembly with the use of air barrier accessories. These accessories include but not limited to tapes, caulks, strips, sheets, etc. By putting an air barrier assembly together and then testing the air leakage rate of the assembly, will provide the building contractor with guidance with how the material needs to be installed on the building and what air barrier accessories are required to seal the pieces of materials together and to the terminations and penetrations.

There are many materials that will meet the requirements of this building code when tested as a material, but will not reduce the air leakage rate of the whole building. Materials like Jello and peanut butter to very rigid materials like ceramics will not perform when subjected to the loads imposed on the material installed in a building. Other materials will simply not stay in place after installation.

Please consider the Air Permeance Comparison Report (10-06-M0027) for Building Professionals at the ABAA website: <http://www.airbarrier.org/technical-information/abaa-articles-standards/>

An example would be a self-adhered material that does not stick to the substrate after installation.

Cost Impact: The code change proposal will increase the cost of construction. There is no increase to the site construction cost. For many manufacturers who have already conducted an air barrier assembly air leakage test, there is no additional costs to them. If a manufacturer has not conducted an air barrier assembly air leakage test on their materials, they would have to conduct this test. The test can run from \$5,000 to \$20,000 for the test, depending on how complex their installation instructions are.

The test is an initial type test which means that the manufacturer conducts the test once for the sales life of the material. An air barrier material can be produced with millions of dollars of sales each year and some material have been on the market for over ten years.

Proposal # 5646

CE100-19

CE101-19

IECC: C402.5.1.2.2, ASTM Chapter 06 (New)

Proponent: Laverne Dalglish, representing Air Barrier Association of America (ldalglish@airbarrier.org)

2018 International Energy Conservation Code

Revise as follows:

C402.5.1.2.2 Assemblies. Assemblies of materials and ~~components~~ assemblies with an average air leakage not greater than 0.04 cfm/ft² (0.2 L/s • m²) under a pressure differential of 0.3 inch of water gauge (w.g.) (75 Pa) when tested in accordance with ASTM E2357, or ASTM E1677 for walls, ASTM D8052 for low slope roofs or ASTM E283 for fenestrations shall comply with this section. Assemblies listed in Items 1 through 3 shall be deemed to comply, provided that joints between materials, penetrations and terminations are sealed and the requirements of Section C402.5.1.1 are met.

1. Concrete masonry walls coated with either one application of block filler or two applications of a paint or sealer coating.
2. Masonry walls constructed of clay or shale masonry units with a nominal width of 4 inches (102 mm) or more.
3. A Portland cement/sand parge, stucco or plaster not less than 1/2 inch (12.7 mm) in thickness.

Add new text as follows:

ASTM

ASTM International
100 Barr Harbor Drive, P.O. Box
C700
West Conshohocken PA 19428-
2959

D8052/D8052M-2017: Standard Test Method for Quantification of Air Leakage in Low-Sloped Membrane Roof Assemblies

Reason: The air barrier industry uses the terms "air barrier material" to be combined with an "air barrier accessory" to form an "air barrier assembly". The term "air barrier component" is used to refer to pre-manufactured elements like doors, windows and skylights, etc. where a separate test is used to determine their air leakage rate.

The test method to determine the air leakage rate of a low sloped roof should be referenced as the existing test methods are not appropriate to test low sloped roofs.

It is important to identify the building assembly that the test method is appropriate for, otherwise people will use the wrong test method for testing their building assembly.

The addition of penetrations and terminations to the areas where joints need to be sealed is to bring to the attention of the reader that all joints need to be sealed.

Cost Impact: The code change proposal will not increase or decrease the cost of construction. This proposal simply clarifies the intent of this part of the building code.

Proposal # 5657

CE101-19

CE102-19

IECC: C402.5.1.2.1

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:

C402.5.1.2.1 Materials. Materials with an air permeability not greater than 0.004 cfm/ft² (0.02 L/s • m²) under a pressure differential of 0.3 inch water gauge (75 Pa) when tested in accordance with ASTM E2178 shall comply with this section. Materials in Items 1 through 16 shall be deemed to comply with this section, provided that joints are sealed and materials are installed as air barriers in accordance with the manufacturer's instructions.

1. Plywood with a thickness of not less than $\frac{3}{8}$ inch (10 mm).
2. Oriented strand board having a thickness of not less than $\frac{3}{8}$ inch (10 mm).
3. Extruded polystyrene insulation board having a thickness of not less than $\frac{1}{2}$ inch (12.7 mm).
4. Foil-back polyisocyanurate insulation board having a thickness of not less than $\frac{1}{2}$ inch (12.7 mm).
5. Closed-cell spray foam having a minimum density of 1.5 pcf (2.4 kg/m³) and having a thickness of not less than 1 $\frac{1}{2}$ inches (38 mm).
6. Open-cell spray foam with a density between 0.4 and 1.5 pcf (0.6 and 2.4 kg/m³) and having a thickness of not less than 4.5 inches (113 mm).
7. Exterior or interior gypsum board having a thickness of not less than $\frac{1}{2}$ inch (12.7 mm).
8. Cement board having a thickness of not less than $\frac{1}{2}$ inch (12.7 mm).
9. Built-up roofing membrane.
10. Modified bituminous roof membrane.
11. ~~Fully adhered~~ single-ply roof membrane.
12. A Portland cement/sand parge, or gypsum plaster having a thickness of not less than $\frac{5}{8}$ inch (15.9 mm).
13. Cast-in-place and precast concrete.
14. Fully grouted concrete block masonry.
15. Sheet steel or aluminum.
16. Solid or hollow masonry constructed of clay or shale masonry units.

Reason: The NRCA's intent here is to provide clarity consistent with ASHRAE Standard 90.1-2013, Addendum 'ay', ASHRAE Standard 90.1-2016, Section 5.4.3.1.3, Item 'b' (7), and language used by roofing industry professionals.

ASHRAE 90.1-2016, Section 5.4.3.1.3, **Testing, Acceptable Materials, and Assemblies**, reads:

- b. Materials that have an air permeance not exceeding 0.004 cfm/ft² under a pressure differential of 0.3 in. of water (1.57 psf) when tested in accordance with ASTM E2178. The following materials meet these requirements:
1. Plywood—minimum 3/8 in.
 2. Oriented strand board—minimum 3/8 in.
 3. Extruded polystyrene insulation board—minimum 1/2 in.
 4. Foil-faced urethane insulation board—minimum 1/2 in.
 5. Exterior gypsum sheathing or interior gypsum board—minimum 1/2 in.
 6. Cement board—minimum 1/2 in.
 7. Built-up roofing membrane
 8. Modified bituminous *roof* membrane
 9. Single-ply *roof* membrane
 10. A Portland cement/sand parge, stucco, or gypsum plaster—minimum 1/2 in. thick
 11. Cast-in-place and precast concrete
 12. Sheet metal
 13. Closed-cell 2 lb/ft³ nominal density spray polyurethane foam—minimum 1 in.

Please see Molleti S., “Evaluation of Air Leakage Properties of Seam-Fastened Mechanically Attached Single-ply and Polymer Modified Bitumen Roof Membrane Assemblies,” NRCC Report No. A1-004336.1, Ottawa, Canada, Sept. 8, 2014. Therein, see the Air Movement Impacts on Roof Systems (AIR) Study, Table 1 “AIR Phase 1 Results,” and Table 2 “AIR Phase 2 Results,” from NRCA “Guidelines for Air Retarders in roof Assemblies.” <https://www.nrca.net/store/detail/nrca-guidelines-for-air-retarders-in-roof-assemblies/1612>

Bibliography: Evaluation of Air Leakage Properties of Seam-Fastened Mechanically Attached Single-ply and Polymer Modified Bitumen Roof Membrane Assemblies,” NRCC Report No. A1-004336.1, Ottawa, Canada, Sept. 8, 2014.

NRCA “Guidelines for Air Retarders in roof Assemblies”

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

The number of code-compliant, single-ply roofing material options available will increase; thereby subjecting local, state, regional, and national markets to competitive pricing pressures.

Proposal # 5210

CE102-19

CE103-19 Part I

PART I — IECC: C402.5.3, C402.5.3.1 (New), BPI Chapter 6

PART II — IECC: R402.4.4.1 (IRC N1102.4.4.1) (New), BPI Chapter 6

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

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

2018 International Energy Conservation Code

Revise as follows:

C402.5.3 Rooms containing fuel-burning appliances- Combustion and Solid-Fuel Burning Appliances. Combustion and solid-fuel burning appliances must be provided with adequate combustion and ventilation air and installed in accordance with manufacturers' installation instructions; NFPA 54/ANSI Z223.1, *National Fuel Gas Code* ; NFPA 31, *Standard for the Installation of Oil-Burning Equipment* ; or NFPA 211, *Standard for Chimneys, Fireplaces, Vents, and Solid-Fuel Burning Appliances* , or other equivalent code approved by the code official .In Climate Zones 3 through 8, where combustion air is supplied through openings in an exterior wall to a room or space containing a space-conditioning fuel-burning appliance, one of the following shall apply:

- ~~1. The room or space containing the appliance shall be located outside of the *building thermal envelope*.~~
- ~~2. The room or space containing the appliance shall be enclosed and isolated from conditioned spaces inside the building thermal envelope. Such rooms shall comply with all of the following:~~
 - ~~2.1. The walls, floors and ceilings that separate the enclosed room or space from conditioned spaces shall be insulated to be not less than equivalent to the insulation requirement of below-grade walls as specified in Table C402.1.3 or C402.1.4.~~
 - ~~2.2. The walls, floors and ceilings that separate the enclosed room or space from conditioned spaces shall be sealed in accordance with Section C402.5.1.1.~~
 - ~~2.3. The doors into the enclosed room or space shall be fully gasketed.~~
 - ~~2.4. Water lines and ducts in the enclosed room or space shall be insulated in accordance with Section C403.~~
 - ~~2.5. Where an air duct supplying combustion air to the enclosed room or space passes through conditioned space, the duct shall be insulated to an *R*-value of not less than *R*-8.~~

Exception: Fireplaces and stoves complying with Sections 901 through 905 of the International Mechanical Code, and Section 2111.14 of the International Building Code.

Add new text as follows:

C402.5.3.1 Testing. Where atmospherically vented combustion appliances or solid-fuel burning appliances are located inside the pressure boundary of the *building thermal envelope*, the total net exhaust flow of the two largest exhaust fans (not including a summer cooling fan(s) intended to be operated only when windows or other air inlets are open) shall not exceed 15 cfm per 100 ft² (75 L/s per 100 m²) of occupiable space when in operation at full capacity.

Where the designed total net flow exceeds this limit, the net exhaust flow must be reduced by reducing the exhaust flow or providing compensating outdoor air. Gravity or barometric dampers in non-powered exhaust

makeup air systems shall not be used to provide compensating outdoor air. Atmospherically-vented combustion appliances do not include direct-vent appliances. Combustion appliances that pass safety testing performed in accordance with BPI-1200, shall be deemed as complying with Section C402.5.3.

Add new standard(s) as follows:

BPI

Building Performance Institute,
Inc.
107 Hermes Road, Suite 210
Malta NY 12020
US

BPI-1200-S-2017: Standard Practice for Basic Analysis of Buildings

Proposal # 5651

CE103-19 Part I

CE103-19 Part II

IECC: R402.4.4.1 (IRC N1102.4.4.1) (New), BPI Chapter 6

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

2018 International Energy Conservation Code

Revise as follows:

R402.4.4 (IRC N1102.4.4) Rooms containing fuel-burning appliances. In *Climate Zones* 3 through 8, where open combustion air ducts provide combustion air to open combustion fuel burning appliances, the appliances and combustion air opening shall be located outside the *building thermal envelope* or enclosed in a room that is isolated from inside the thermal envelope. Such rooms shall be sealed and insulated in accordance with the envelope requirements of Table R402.1.2, where the walls, floors and ceilings shall meet not less than the *basement wall R-value* requirement. The door into the room shall be fully gasketed and any water lines and ducts in the room insulated in accordance with Section R403. The combustion air duct shall be insulated where it passes through *conditioned space* to an Rvalue of not less than R-8.

Exceptions:

1. Direct vent appliances with both intake and exhaust pipes installed continuous to the outside.
2. Fireplaces and stoves complying with Section R402.4.2 and Section R1006 of the International Residential Code.

Add new text as follows:

R402.4.4.1 (IRC N1102.4.4.1) Testing. Where atmospherically vented combustion appliances or solid-fuel burning appliances are located inside the pressure boundary of the *building thermal envelope*, the total net exhaust flow of the two largest exhaust fans (not including a summer cooling fan(s) intended to be operated only when windows or other air inlets are open) shall not exceed 15 cfm per 100 ft² (75 L/s per 100 m²) of occupiable space when in operation at full capacity.

Where the designed total net flow exceeds this limit, the net exhaust flow must be reduced by reducing the exhaust flow or providing compensating outdoor air. Gravity or barometric dampers in non-powered exhaust makeup air systems shall not be used to provide compensating outdoor air. Atmospherically-vented combustion appliances do not include direct-vent appliances. Combustion appliances that pass safety testing performed in accordance with BPI-1200-S shall be deemed as complying with Section R402.4.4.

Add new standard(s) as follows:

BPI

Building Performance Institute,
Inc.
107 Hermes Road, Suite 210
Malta NY 12020
US

BPI-1200-S-2017: Standard Practice for Basic Analysis of Buildings.

Reason: Energy efficiency improvements often have a direct impact on the building pressure boundary affecting the safe operation of combustion equipment. Routinely sealing up buildings without looking at the combustion equipment risk sooner or later will result in harming someone with back-drafted flue gas conditions.

The current language requires thermal isolation and enclosure of the mechanical room. A "worst case" depressurization test would, at worst, be equal in estimated first cost.

This proposal is intended to provide clear guidance to builders, code officials and home performance contractors for worst-case testing of atmospheric venting systems where air-sealing techniques and air-leakage performance testing requirements of the 2018 IECC are employed. Worst case testing is used by home performance contractors to identify problems that weaken draft and restrict combustion air. Worst case vent testing uses the home's exhaust fans, air handling appliances and chimneys to create worst case depressurization in the combustion appliance zone.

Language that is proposed for R403.10 is basically a distilled version of predominant combustion safety test procedures for atmospherically vented appliances found in readily available home performance programs across the country. Specific reference is made to ANSI/BPI-1200, *Standard Practice for Basic Analysis of Buildings*.

Bibliography: ANSI Z223.1-2018, *National Fuel Gas Code*;
NFPA 31-2016, *Standard for the Installation of Oil-Burning Equipment*;

NFPA 211-2016, *Standard for Chimneys, Fireplaces, Vents, and Solid-Fuel Burning Appliances*; and

ANSI/BPI-1200-S-2017, *Standard Practice for Basic Analysis of Buildings*.

Cost Impact: The code change proposal will increase the cost of construction
The current language requires thermal isolation and enclosure of the mechanical room.

We suggest that "trading-off" those first costs with the \$200 - \$300 cost for a "worst case" depressurization test would, at worst, be equal.

Staff Analysis: A review of the standard proposed for inclusion in the code, ANSI/BPI-1200-S-2017, 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.

Proposal # 5760

CE103-19 Part II

CE104-19

IECC: C402.5.3

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

Delete without substitution:

~~C402.5.3 Rooms containing fuel-burning appliances.~~ In *Climate Zones* 3 through 8, where combustion air is supplied through openings in an exterior wall to a room or space containing a space-conditioning fuel-burning appliance, one of the following shall apply:

- ~~1. The room or space containing the appliance shall be located outside of the *building thermal envelope*.~~
- ~~2. The room or space containing the appliance shall be enclosed and isolated from conditioned spaces inside the building thermal envelope. Such rooms shall comply with all of the following:~~
 - ~~2.1. The walls, floors and ceilings that separate the enclosed room or space from conditioned spaces shall be insulated to be not less than equivalent to the insulation requirement of below-grade walls as specified in Table C402.1.3 or C402.1.4.~~
 - ~~2.2. The walls, floors and ceilings that separate the enclosed room or space from conditioned spaces shall be sealed in accordance with Section C402.5.1.1.~~
 - ~~2.3. The doors into the enclosed room or space shall be fully gasketed.~~
 - ~~2.4. Water lines and ducts in the enclosed room or space shall be insulated in accordance with Section C403.~~
 - ~~2.5. Where an air duct supplying combustion air to the enclosed room or space passes through conditioned space, the duct shall be insulated to an *R*-value of not less than *R*-8.~~

~~Exception:~~ Fireplaces and stoves complying with Sections 901 through 905 of the International Mechanical Code, and Section 2111.14 of the International Building Code.

Reason: The language in the IECC R402.5.3 is deleted in its entirety with no replacement language. Many of the appliances installed today due to Federal Energy Efficiency requirements and customer demands, are direct vent appliances with both intake and exhaust pipes continuous to the outside as listed in exception #1. The concern of this original code change is that the colder air that is installed as combustion air needs to be tempered or conditioned to the temperature of the rest of the building. The thought is that this will save money by not having to warm this colder air once it enters the building. There are advantages to having this open combustion air duct, in the area of the mechanicals in case any of the mechanical combustion appliances need additional air for proper combustion, this opening will supply it. This is a simple safety issue to make combustion air available. Remember, the code is not allowed to create a life safety issue. However the fallacy is in the thought process that this open duct is constantly bringing in cooler or warmer air into the building (depending on the season of the year and your climate zone,). This does not happen. There are some very simple and successful ways to prevent air from entering the building when it's not needed for combustion. With a 90 degree bend in the duct (the most common way) or placing the end of the duct in a pail or container etc. This can be done without the added costs of building walls around the mechanical room that meet the same requirements of the exterior walls of the home including air leakage, and R-values and U factors of the wall system. The average cost of framing a 10 foot wall is between \$150 and \$360 for labor and material, depending on location of the country you are building in. Add to that cost an additional \$50 to \$75 for insulation and another \$100 to \$150 for

air sealing and the costs add up very fast. These costs don't even include the average exterior type of door that is required to be gasketed and sealed. Add another \$250 to \$300 not including Labor. And an additional \$50 to \$75 for the hardware, frame and door knobs. So where are the savings for meeting this code change? The fact is that the additional costs to do this are between \$500.00 on the very low end, and \$900 or more, on the higher end. This makes no sense. This code section is trying to solve a problem that does not exist. Especially if the building meets the air tightness requirements of the code already. Also the temperature on both sides of this very expensive wall system is basically the same temperature, why the need for insulation then? Building Physics will dictate that air needs a pressure differential, and a hole, to move air through these walls. Without both a pressure differential and a hole, air will not move. There will not be walls that are separating outside unconditioned air from interior conditioned air, and there will be essentially very little, or no pressure difference from one side of these walls to the other side because there is not going to be a Delta T (Temperature difference). Both sides will be conditioned space. With the cost of housing growing so fast in our country today let's not keep code changes in the code that cost a lot of money, for no return on the investment (ROI)

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

The cost factor of doing all this work to isolate theism room if and when a passive combustion air is brought into the space costs so much more than the language of the code will ever save in the first place.

Proposal # 5130

CE104-19

CE105-19

IECC: C402.5.7.1

Proponent: Dan Buuck, representing National Association of Home Builders (dbuuck@nahb.org); David Collins, representing The American Institute of Architects (dcollins@preview-group.com); Gene Boecker, representing Code Consultants, Inc. (geneb@codeconsultants.com); Marsha Mazz, representing United Spinal Association (m.mazz@verizon.net); Dawn Anderson, representing Mayor's Office on Disability (gonedawning@yahoo.com)

2018 International Energy Conservation Code

C402.5.7 Vestibules. Building entrances shall be protected with an enclosed vestibule, with all doors opening into and out of the vestibule equipped with self-closing devices. Vestibules shall be designed so that in passing through the vestibule it is not necessary for the interior and exterior doors to open at the same time. The installation of one or more revolving doors in the building entrance shall not eliminate the requirement that a vestibule be provided on any doors adjacent to revolving doors.

Exceptions: Vestibules are not required for the following:

1. Buildings in *Climate Zones* 1 and 2.
2. Doors not intended to be used by the public, such as doors to mechanical or electrical equipment rooms, or intended solely for employee use.
3. Doors opening directly from a *sleeping unit* or dwelling unit.
4. Doors that open directly from a space less than 3,000 square feet (298 m²) in area.
5. Revolving doors.
6. Doors used primarily to facilitate vehicular movement or material handling and adjacent personnel doors.
7. Doors that have an air curtain with a velocity of not less than 6.56 feet per second (2 m/s) at the floor that have been tested in accordance with ANSI/AMCA 220 and installed in accordance with the manufacturer's instructions. Manual or automatic controls shall be provided that will operate the air curtain with the opening and closing of the door. Air curtains and their controls shall comply with Section C408.2.3.

Add new text as follows:

C402.5.7.1 Vestibules and revolving doors. Revolving doors shall comply with Section 1010.1.4.1 of the International Building Code. Vestibules shall comply with Section 1010.1.8 of the International Building Code. Where a vestibule serves as part of an accessible route, the vestibule shall also comply Section 404 of ICC A117.1. Automatic doors shall be provided in accordance with Section 1105.1.1 of the International Building Code.

Reason: This is a necessary reference for the designer to fully understand the implications for the design of the vestibule given the new automatic door requirements in the IBC and the turning space requirements in the ICC A117.1.

Cost Impact: The code change proposal will not increase or decrease the cost of construction
This is a pointer to aid the designer.

Proposal # 4401

CE105-19

CE106-19

IECC: C402.5.9(New), C402.5.9.1(New), C403.1.3(New)

Proponent: Hope Medina, representing Self (hmedina@coloradocode.net)

2018 International Energy Conservation Code

Add new text as follows:

C402.5.9 Operable openings interlocking. (Mandatory) Occupancies that utilize an operable opening larger than 40 square feet shall have the openings interlocked with the heating and cooling system to raise the cooling setpoint to 80 degrees or heating to 70 degrees when the operable opening is open in the exterior wall of the building.

Exceptions:

1. Food cooking and prep areas that contain equipment that contributes to the mechanical load calculations of a restaurant type occupancy that are zoned separately.
2. Warehouses that utilize overhead doors for the function of the occupancy, where approved by the code official.
3. The first entrance doors where located in the exterior wall and are part of a vestibule system.

C402.5.9.1 Operable controls (Mandatory) Controls shall comply with Section C403.13.

C403.13 Operable opening interlocking controls. (Mandatory) The heating and cooling systems shall have controls that will interlock these mechanical systems to the set temperatures of 80 degrees for cooling and 70 degrees for heating when the conditions of Section C402.5.9 exist. The controls shall configure to shut off the systems entirely when the outdoor temperatures are below 80 degrees or above 70 degrees.

Reason: It has become a frequent practice for large operable windows, roll up doors, and/or sliding or folding doors to be installed and open to take advantage of cross ventilation or wind to assist with cooling and ventilation of a space. The problem has become that the cooling and heating systems for these spaces are still running, which does not assist with the energy efficiency of a building or space. The intent of this proposal is to address this common practice with a practical approach that utilizes similar concepts in other standards and other jurisdictional amendments without “banning” this practice.

The exceptions are needed to address very specific situations this requirement would hinder the function of the space. When preparing food often the equipment utilized is going to increase the need for mechanical cooling, and it is not the intent to cause any discomfort. The exceptions allow for the food prep areas to still utilize the mechanical cooling system. The second exception acknowledges that many warehouses will utilize natural ventilation, and these doors are often opened for this reason. The third exception is to address when the entrance door is opened for people who are coming and going of the space.

The controls for these systems would not need to be on when the outdoor temperatures have reached the set temperatures.

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

While this requirement will have an increase of cost on the front end it should decrease the operation cost post construction.

CE107-19

IECC: C403.1.1

Proponent: David Collins, representing SEHPCAC (SEHPCAC@iccsafe.org)

2018 International Energy Conservation Code

Revise as follows:

C403.1.1 Calculation of heating and cooling loads (Mandatory). Design loads associated with heating, ventilating and air conditioning of the building shall be determined in accordance with ANSI/ASHRAE/ACCA Standard 183 or by an *approved* equivalent computational procedure using the design parameters specified in Chapter 3. Heating and cooling loads shall be adjusted to account for load reductions that are achieved where energy recovery systems are utilized in the HVAC system in accordance with the ASHRAE *HVAC Systems and Equipment Handbook* by an approved equivalent computational procedure.

Reason:

C403.1.1 is currently called out in C403.3.1, which is labeled mandatory; prior to the reorganization in the 2018 code, it was under charging language 403.2 which was labeled mandatory.

While identified as "Mandatory", if the elimination of the use of the labels "prescriptive" and "mandatory" is approved, we understand this label would not be added and it would instead the provision be added to Table C407.2 to indicate its application to the Total Building Performance compliance option.

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>
(<http://www.iccsafe.org/cs/SEHPCAC/Pages/default.aspx>)

Cost Impact: The code change proposal will not increase or decrease the cost of construction. Because this is a clarification and reaffirmation of the mandatory nature of this requirement, it should not increase or decrease costs of construction.

Proposal # 4183

CE107-19

CE108-19

IECC: C202, C202(New), C403.1, C403.1.2 (New), TABLE C403.1.2(1) (New), TABLE C403.1.2(2)(New), TABLE C403.3.2(9), C405.1, TABLE C405.3.2(2), Chapter 6CE (New)

Proponent: Nicholas O'Neil, Energy 350, representing Energy 350 (noneil@energy350.com)

2018 International Energy Conservation Code

SECTION C202 GENERAL DEFINITIONS

Revise as follows:

COMPUTER ROOM. A room whose primary function is to house equipment for the processing and storage of electronic data ~~and that which~~ has a design ~~electronic data total~~ ITE equipment power density of less than ~~or equal to~~ 20 watts per square foot (20 watts per 0.092 m²) of conditioned floor area or a ~~connected~~ design ~~electronic data total~~ ITE equipment load of less than ~~or equal to~~ 10 kW.

Add new definition as follows:

DATA CENTER. A room, or series of rooms that share data center systems, whose primary function is to house equipment for the processing and storage of electronic data and which has a design total ITE equipment power density exceeding 20 watts per square foot of conditioned area and a total design ITE equipment load greater than 10 kW.

DATA CENTER SYSTEMS. HVAC systems and equipment, or portions thereof used to provide cooling or ventilation in a data center.

INFORMATION TECHNOLOGY EQUIPMENT (ITE) ITE includes computers, data storage devices, servers, and network/communication equipment.

Revise as follows:

C403.1 General. Mechanical systems and equipment serving the building heating, cooling, ventilating or refrigerating needs shall comply with this section.

Exception: Data center systems are exempt from the requirements of Sections C403.4 and C403.5.

Add new text as follows:

C403.1.2 Data Centers Data center systems shall comply with Sections 6 and 8 of ASHRAE 90.4 with the following changes:

1. Replace design MLC values in the ASHRAE 90.4 specified in Table 6.2.1.1 with the values in Table C403.1.2(1) as applicable in each climate zone.
2. Replace annualized MLC values in the ASHRAE 90.4 specified in Table 6.2.1.2 with the values in Table C403.1.2(2) as applicable in each climate zone.

C403.1.2(1)

Maximum Design Mechanical Load Component (Design MLC)

Climate Zones as Listed in ASHRAE Standard 169	Design MLC at 100% and at 50% ITE Load
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<u>0A</u>	<u>0.24</u>
<u>0B</u>	<u>0.26</u>
<u>1A</u>	<u>0.23</u>
<u>2A</u>	<u>0.24</u>
<u>3A</u>	<u>0.23</u>
<u>4A</u>	<u>0.23</u>
<u>5A</u>	<u>0.22</u>
<u>6A</u>	<u>0.22</u>
<u>1B</u>	<u>0.28</u>
<u>2B</u>	<u>0.27</u>
<u>3B</u>	<u>0.26</u>
<u>4B</u>	<u>0.23</u>
<u>5B</u>	<u>0.23</u>
<u>6B</u>	<u>0.21</u>
<u>3C</u>	<u>0.19</u>
<u>4C</u>	<u>0.21</u>
<u>5C</u>	<u>0.19</u>
<u>7</u>	<u>0.20</u>
<u>8</u>	<u>0.19</u>

C403.1.2(2)

Maximum Annualized Mechanical Load Component (Annualized MLC)

<u>Climate Zones as Listed in ASHRAE Standard 169</u>	<u>HVAC Maximum Annualized MLC at 100% and at 50% ITE Load</u>
<u>0A</u>	<u>0.19</u>
<u>0B</u>	<u>0.20</u>
<u>1A</u>	<u>0.18</u>
<u>2A</u>	<u>0.19</u>
<u>3A</u>	<u>0.18</u>
<u>4A</u>	<u>0.17</u>
<u>5A</u>	<u>0.17</u>
<u>6A</u>	<u>0.17</u>
<u>1B</u>	<u>0.16</u>
<u>2B</u>	<u>0.18</u>
<u>3B</u>	<u>0.18</u>
<u>4B</u>	<u>0.18</u>
<u>5B</u>	<u>0.16</u>
<u>6B</u>	<u>0.17</u>
<u>3C</u>	<u>0.16</u>

<u>4C</u>	<u>0.16</u>
<u>5C</u>	<u>0.16</u>
<u>7</u>	<u>0.16</u>
<u>8</u>	<u>0.16</u>

Revise as follows:

TABLE C403.3.2(9)
MINIMUM EFFICIENCY AIR CONDITIONERS AND CONDENSING UNITS SERVING COMPUTER ROOMS
AND DATA CENTERS

EQUIPMENT TYPE	NET SENSIBLE COOLING CAPACITY^a	MINIMUM SCOP-127^b EFFICIENCY DOWNFLOW UNITS / UPFLOW UNITS	TEST PROCEDURE
Air conditioners, air cooled	< 65,000 Btu/h	2.20 / 2.09	ANSI/ASHRAE 127
	≥ 65,000 Btu/h and < 240,000 Btu/h	2.10 / 1.99	
	≥ 240,000 Btu/h	1.90 / 1.79	
Air conditioners, water cooled	< 65,000 Btu/h	2.60 / 2.49	
	≥ 65,000 Btu/h and < 240,000 Btu/h	2.50 / 2.39	
	≥ 240,000 Btu/h	2.40 / 2.29	
Air conditioners, water cooled with fluid economizer	< 65,000 Btu/h	2.55 / 2.44	
	≥ 65,000 Btu/h and < 240,000 Btu/h	2.45 / 2.34	
	≥ 240,000 Btu/h	2.35 / 2.24	
Air conditioners, glycol cooled (rated at 40% propylene glycol)	< 65,000 Btu/h	2.50 / 2.39	
	≥ 65,000 Btu/h and < 240,000 Btu/h	2.15 / 2.04	
	≥ 240,000 Btu/h	2.10 / 1.99	
Air conditioners, glycol cooled (rated at 40% propylene glycol) with fluid economizer	< 65,000 Btu/h	2.45 / 2.34	
	≥ 65,000 Btu/h and < 240,000 Btu/h	2.10 / 1.99	
	≥ 240,000 Btu/h	2.05 / 1.94	

For SI: 1 British thermal unit per hour = 0.2931 W.

- a. Net sensible cooling capacity: the total gross cooling capacity less the latent cooling less the energy to the air movement system. (Total Gross – latent – Fan Power).
- b. Sensible coefficient of performance (SCOP-127): a ratio calculated by dividing the net sensible cooling capacity in watts by the total power input in watts (excluding reheaters and humidifiers)

at conditions defined in ASHRAE Standard 127. The net sensible cooling capacity is the gross sensible capacity minus the energy dissipated into the cooled space by the fan system.

C405.1 General (Mandatory). This section covers lighting system controls, the maximum lighting power for interior and exterior applications and electrical energy consumption.

Dwelling units within multifamily buildings shall comply with Section R404.1. All other dwelling units shall comply with Section R404.1, or with Sections C405.2.4 and C405.3. Sleeping units shall comply with Section C405.2.4, and with Section R404.1 or C405.3. Lighting installed in walk-in coolers, walk-in freezers, refrigerated warehouse coolers and refrigerated warehouse freezers shall comply with the lighting requirements of Section C403.10.1 or C403.10.2. Transformers, uninterruptable power supplies, motors and electrical power processing equipment in data center systems shall comply with Section 8 of ASHRAE 90.4 in addition to this code.

TABLE C405.3.2(2)
INTERIOR LIGHTING POWER ALLOWANCES: SPACE-BY-SPACE METHOD

COMMON SPACE TYPES ^a	LPD (watts/sq.ft)
Atrium	
Less than 40 feet in height	0.03 per foot in total height
Greater than 40 feet in height	0.40 + 0.02 per foot in total height
Audience seating area	
In an auditorium	0.63
In a convention center	0.82
In a gymnasium	0.65
In a motion picture theater	1.14
In a penitentiary	0.28
In a performing arts theater	2.03
In a religious building	1.53
In a sports arena	0.43
Otherwise	0.43
Banking activity area	0.86
Breakroom (See Lounge/breakroom)	
Classroom/lecture hall/training room	
In a penitentiary	1.34
Otherwise	0.96
Computer room, <u>Data Center</u>	1.33
Conference/meeting/multipurpose room	1.07
Copy/print room	0.56
Corridor	
In a facility for the visually impaired (and not used primarily by the staff) ^b	0.92
In a hospital	0.92
In a manufacturing facility	0.29
Otherwise	0.66
Courtroom	1.39

Dining area	
In bar/lounge or leisure dining	0.93
In cafeteria or fast food dining	0.63
In a facility for the visually impaired (and not used primarily by the staff) ^b	2.00
In family dining	0.71
In a penitentiary	0.96
Otherwise	0.63
Electrical/mechanical room	0.43
Emergency vehicle garage	0.41
Food preparation area	1.06
Guestroom ^{c, d}	0.77
Laboratory	
In or as a classroom	1.20
Otherwise	1.45
Laundry/washing area	0.43
Loading dock, interior	0.58
Lobby	
For an elevator	0.68
In a facility for the visually impaired (and not used primarily by the staff) ^b	2.03
In a hotel	1.06
In a motion picture theater	0.45
In a performing arts theater	1.70
Otherwise	1.0
Locker room	0.48
Lounge/breakroom	
In a healthcare facility	0.78
Otherwise	0.62
Office	
Enclosed	0.93
Open plan	0.81
Parking area, interior	0.14
Pharmacy area	1.34
Restroom	
In a facility for the visually impaired (and not used primarily by the staff) ^b	0.96
Otherwise	0.85
Sales area	1.22
Seating area, general	0.42
Stairway (see Space containing stairway)	
Stairwell	0.58
Storage room	0.46

Vehicular maintenance area	0.56
Workshop	1.14
BUILDING TYPE SPECIFIC SPACE TYPES ^a	LPD (watts/sq.ft)
Automotive (see Vehicular maintenance area)	
Convention Center—exhibit space	0.88
Dormitory—living quarters ^{c, d}	0.54
Facility for the visually impaired ^b	
In a chapel (and not used primarily by the staff)	1.06
In a recreation room (and not used primarily by the staff)	1.80
Fire Station—sleeping quarters ^c	0.20
Gymnasium/fitness center	
In an exercise area	0.50
In a playing area	0.82
Healthcare facility	
In an exam/treatment room	1.68
In an imaging room	1.06
In a medical supply room	0.54
In a nursery	1.00
In a nurse's station	0.81
In an operating room	2.17
In a patient room ^c	0.62
In a physical therapy room	0.84
In a recovery room	1.03
Library	
In a reading area	0.82
In the stacks	1.20
Manufacturing facility	
In a detailed manufacturing area	0.93
In an equipment room	0.65
In an extra-high-bay area (greater than 50' floor-to-ceiling height)	1.05
In a high-bay area (25-50' floor-to-ceiling height)	0.75
In a low-bay area (less than 25' floor-to-ceiling height)	0.96
Museum	
In a general exhibition area	1.05
In a restoration room	0.85
Performing arts theater—dressing room	0.36
Post office—sorting area	0.68
Religious buildings	
In a fellowship hall	0.55
In a worship/pulpit/choir area	1.53

Retail facilities	
In a dressing/fitting room	0.50
In a mall concourse	0.90
Sports arena—playing area	
For a Class I facility ^e	2.47
For a Class II facility ^f	1.96
For a Class III facility ^g	1.70
For a Class IV facility ^h	1.13
Transportation facility	
In a baggage/carousel area	0.45
In an airport concourse	0.31
At a terminal ticket counter	0.62
Warehouse—storage area	
For medium to bulky, palletized items	0.35
For smaller, hand-carried items	0.69

- a. In cases where both a common space type and a building area specific space type are listed, the building area specific space type shall apply
- b. A 'Facility for the Visually Impaired' is a facility that is licensed or will be licensed by local or state authorities for senior long-term care, adult daycare, senior support or people with special visual needs.
- c. Where sleeping units are excluded from lighting power calculations by application of Section R405.1, neither the area of the sleeping units nor the wattage of lighting in the sleeping units is counted.
- d. Where dwelling units are excluded from lighting power calculations by application of Section R405.1, neither the area of the dwelling units nor the wattage of lighting in the dwelling units is counted.
- e. Class I facilities consist of professional facilities; and semiprofessional, collegiate, or club facilities with seating for 5,000 or more spectators.
- f. Class II facilities consist of collegiate and semiprofessional facilities with seating for fewer than 5,000 spectators; club facilities with seating for between 2,000 and 5,000 spectators; and amateur league and high-school facilities with seating for more than 2,000 spectators.
- g. Class III facilities consist of club, amateur league and high-school facilities with seating for 2,000 or fewer spectators.
- h. Class IV facilities consist of elementary school and recreational facilities; and amateur league and high-school facilities without provision for spectators.

Add new standard(s) as follows:

ASHRAE

ASHRAE
1791 Tullie Circle NE
Atlanta GA 30329

90.4-2016: Energy Standard for Data Centers

Reason: Data centers have long had difficulty meeting all prescriptive code requirements and are additionally discouraged from pursuing more efficient alternatives with useful waste heat. Instead of current prescriptive

code language (emphasizing component performance ratings and cooler-weather economization) this proposal seeks to require large sophisticated data center projects to meet a performance-based ASHRAE Standard allowing attractive system-wide tradeoffs for efficiency and explicit credit for useful heat recovery. While data centers pursuing this path may experience energy savings, this proposal seeks to instill a performance-based approach to encourage more efficient design overall using a methodology that better suits this unique building type.

Cost Impact: The code change proposal will not increase or decrease the cost of construction. We do not anticipate any significant financial impacts to be incurred due to this change.

Staff Analysis: A review of the standard proposed for inclusion in the code, ASHRAE 90.4-2016, 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.

Analysis: A review of the standard proposed for inclusion in the code, ASHRAE 90.4-2016, 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.

Proposal # 4949

CE108-19

CE109-19

IECC: C403.2.2.1 (New)

Proponent: Joel Williams, TEXENERGY SOLUTIONS, representing TexEnergy Solutions

2018 International Energy Conservation Code

Add new text as follows:

C403.2.2.1 Multifamily ventilation addition. For unitary systems less than 65,000 KBTU/Yr serving a multifamily dwelling unit with a individual ventilation system having a fan either partially or completely dedicated to ventilation shall have a fan size no larger than ¼ horsepower.

Reason: We work mostly in multifamily commercial construction. The intent of this change is to move away from the primary strategy for ventilation (CZ1-3) being a duct with a damper attached to the return plenum. This brings in additional moisture due to the lack of control and design of the system.

Bibliography: Performance path energy models (REMRate/Ekotrope) for low-rise apartments do a good job of showing this impact. They take the fan power for the apartments and compare them against a baseline of 2.2 CFM/Watt (0.46 W/CFM) for the ventilation of the building and rate it on how many hours a day that it will run. It disincentivizes the air handler strategy in the performance code path and helps promote a more effective ventilation system.

Cost Impact: The code change proposal will increase the cost of construction. Since this is multifamily construction, most of the units are between 1.5T and 3.0T in sizing. Most projects use the air handler fan and put a duct with a damper to bring in the fresh air for their apartments. This would force a decision to buy more efficient equipment and not upsize the air handler to get a higher equipment efficiency at the detriment of the additional power used by the ventilation fan strategy.

Proposal # 5137

CE109-19

CE110-19

IECC: C202(New), C403.2, C403.2.3(New)

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

SECTION C202 GENERAL DEFINITIONS

Add new definition as follows:

FAULT DETECTION AND DIAGNOSTICS (FDD) SYSTEM. A software platform that utilizes building analytic algorithms to convert data provided by sensors and devices to automatically identify faults in building systems and provide a prioritized list of actionable resolutions to those faults based on cost or energy avoidance, comfort and maintenance impact.

Revise as follows:

C403.2 System design (Mandatory). Mechanical systems shall be designed to comply with Sections C403.2.1 and ~~C403.2.2 through C403.2.3~~. Where elements of a building's mechanical systems are addressed in Sections C403.3 through C403.12, such elements shall comply with the applicable provisions of those sections.

Add new text as follows:

C403.2.3 Fault Detection and Diagnostics (Mandatory). Buildings having 100,000 square feet (9,290 square meters) or more of *conditioned floor area* shall include a fault detection and diagnostics (FDD) system to monitor the building's HVAC system's performance and automatically identify faults. The FDD system shall:

1. Utilize permanently installed sensors and devices to monitor the HVAC system's central plant equipment, zone terminal equipment and associated mechanical components including but not limited to motors, actuators, valves and dampers;
2. Sample the permanently installed sensors and devices at least once per 15 minutes;
3. Automatically identify HVAC system faults using algorithmic-based analysis that performs rule-based or model-based diagnostics separately from the monitoring and alarming functionality of a building management system (BMS) or building automation system (BAS);
4. Automatically provide authorized personnel with prioritized recommendations for fault repair of identified faults based on estimated excess energy consumption or cost of non-repair; and
5. Be capable of transmitting the prioritized fault repair recommendations to remotely located authorized personnel.

Reason: The purpose of this code change proposal is to add a requirement for Fault Detection and Diagnostics (FDD) for HVAC systems in large commercial buildings. Energy efficiency of a new building's HVAC system will degrade over time if equipment is poorly maintained, failing, or improperly controlled. The proposed FDD requirement will reduce that degradation by detecting HVAC system faults and notifying building operators so that corrective actions may be taken to repair the faults and reduce the energy consumption of the building. In addition, FDD systems are commonly utilized to drive operational efficiency, make better use of maintenance personnel, and resolve comfort issues.

Bibliography: “Realizing ongoing energy and cost savings,” *available at* <https://ecobuilding.schneider-electric.com/documents/10807/217223/Lab+Project+Building+Analytics+Case+Study/a6d8b9b6-7fdd-4e87-a90b-c98ece595a25>

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

This proposal will increase the cost of construction because it will require additional hardware, software and/or labor during installation of the mechanical system. However, based on field experience with FDD systems, we believe that these systems will rapidly pay for themselves. A recent study of a FDD system installed in a research lab in Massachusetts showed that the equipment would produce a return on investment of less than one year. See “Realizing ongoing energy and cost savings,” *available at* <https://ecobuilding.schneider-electric.com/documents/10807/217223/Lab+Project+Building+Analytics+Case+Study/a6d8b9b6-7fdd-4e87-a90bc98ece595a25>:

- Setup cost: \$23,190
- Annual maintenance cost: \$35,407
- Projected annual savings: \$286,000

Proposal # 4206

CE110-19

CE111-19

IECC: C202, (New), C403.2, C403.2.3(New)

Proponent: Marilyn Williams, representing National Electrical Manufacturers Association
(mar_williams@nema.org)

2018 International Energy Conservation Code

SECTION C202 GENERAL DEFINITIONS

Add new text as follows:

FAULT DETECTION AND DIAGNOSTICS (FDD) SYSTEM A software platform that utilizes building analytic algorithms to convert data provided by sensors and devices to automatically identify faults in building systems and provide a prioritized list of actionable resolutions to those faults based on cost or energy avoidance, comfort and maintenance impact.

Revise as follows:

C403.2 System design (Mandatory). Mechanical systems shall be designed to comply with Sections C403.2.1 and ~~C403.2.2 through C403.2.3~~. Where elements of a building's mechanical systems are addressed in Sections C403.3 through C403.12, such elements shall comply with the applicable provisions of those sections.

Add new text as follows:

C403.2.3 Fault Detection and Diagnostics (Mandatory) New buildings with a gross conditioned floor area of 100,000 square feet (9290 square meters) or larger shall include a fault detection and diagnostics (FDD) system to monitor the HVAC system's performance and automatically identify faults. The FDD system shall:

1. Include permanently installed sensors and devices to monitor the HVAC system's performance;
2. Sample the HVAC system's performance at least once per 15 minutes;
3. Automatically identify and report HVAC system faults;
4. Automatically notify authorized personnel of identified HVAC system faults;
5. Automatically provide prioritized recommendations for repair of identified faults based on analysis of data collected from the sampling of HVAC system performance; and
6. Be capable of transmitting the prioritized fault repair recommendations to remotely located authorized personnel.

Reason: Energy efficiency of a new building's HVAC system will degrade over time caused by poorly maintained, failing and improperly controlled equipment. The proposed FDD requirement will reduce that degradation by detecting HVAC system faults and notifying building operators so that actions may be taken to reduce energy consumption of the building. Additionally, FDD systems are being utilized to drive operational efficiency, make better use of maintenance personnel, and resolve comfort issues.

Cost Impact: The code change proposal will not increase or decrease the cost of construction. The code change proposal "will" increase the cost of construction because it will require additional hardware, software and labor during installation. Providing specific cost would violate antitrust laws, however a published example of cost and savings is provided from the following link <https://ecobuilding.schneider-electric.com/documents/10807/217223/Lab+Project+Building+Analytics+Case+Study/a6d8b9b6-7fdd-4e87-a90b-c98ece595a25>: Setup/install cost - \$23,190, Annual maintenance cost - \$35,407, and Annual savings - \$286,000.

CE112-19

IECC: TABLE C403.3.2(5)

Proponent: Steven Rosenstock, Edison Electric Institute, representing Edison Electric Institute (srosenstock@eei.org)

2018 International Energy Conservation Code

Revise as follows:

TABLE C403.3.2(5)
MINIMUM EFFICIENCY REQUIREMENTS: GAS- AND OIL-FIRED BOILERS

Portions of table not shown remain unchanged.

EQUIPMENT TYPE ^a	SUBCATEGORY OR RATING CONDITION	SIZE CATEGORY (INPUT)	MINIMUM EFFICIENCY ^{d, e}	TEST PROCEDURE
Boilers, steam	Gas-fired	< 300,000 Btu/h ^f	80% AFUE	10 CFR Part 430
	Gas-fired- all, except natural draft	≥ 300,000 Btu/h and ≤ 2,500,000 Btu/h ^b	79% E _t	10 CFR Part 431
		> 2,500,000 Btu/h ^a	79% E _t	
	Gas-fired-natural draft	≥ 300,000 Btu/h and ≤ 2,500,000 Btu/h ^b	77% E _t <u>79% E_t as of</u> <u>March 2,2020</u>	
		> 2,500,000 Btu/h ^a	77% E _t <u>79% E_t as of Mach</u> <u>2.2020</u>	
		< 300,000 Btu/h	82% AFUE	10 CFR Part 430
	Oil-fired ^c	≥ 300,000 Btu/h and ≤ 2,500,000 Btu/h ^b	81% E _t	10 CFR Part 431
		> 2,500,000 Btu/h ^a	81% E _t	

For SI: 1 British thermal unit per hour = 0.2931 W.

- These requirements apply to boilers with rated input of 8,000,000 Btu/h or less that are not packaged boilers and to all packaged boilers. Minimum efficiency requirements for boilers cover all capacities of packaged boilers.
- Maximum capacity – minimum and maximum ratings as provided for and allowed by the unit's controls.
- Includes oil-fired (residual).
- E_c = Combustion efficiency (100 percent less flue losses).
- E_t = Thermal efficiency. See referenced standard for detailed information.
- Boilers shall not be equipped with a constant-burning ignition pilot.
- A boiler not equipped with a tankless domestic water heating coil shall be equipped with an

automatic means for adjusting the temperature of the water such that an incremental change in inferred heat load produces a corresponding incremental change in the temperature of the water supplied.

Reason: This will align the IECC with the required minimum efficiency values shown in ASHRAE 90.1-2016 (and 2013, 2010, and 2007) Table 6.8.1-6, "Gas and Oil Fired *Boilers* - Minimum *Efficiency* Requirements". These values were agreed to on a consensus basis by the ASHRAE Mechanical SubCommittee, the ASHRAE 90.1 Full Committee, and then went out for public review before being published.

Cost Impact: The code change proposal will increase the cost of construction
There will be an increase in cost to install higher efficiency equipment.

Proposal # 4726

CE112-19

CE113-19

IECC: C403.3.2, TABLE C403.3.2(1), TABLE C403.3.2(2), TABLE C403.3.2(3), TABLE C403.3.2(4), TABLE C403.3.2(5), TABLE C403.3.2(6), TABLE C403.3.2(7), TABLE C403.3.2(8), TABLE C403.3.2(9), TABLE C403.3.2(10), C403.3.2.1, C403.3.2.2, C403.5.5, C403.9, C406.2, TABLE C407.5.1(1), C408.2.3.1

Proponent: Connor Barbaree, representing ASHRAE (cbarbaree@ashrae.org)

2018 International Energy Conservation Code

Revise as follows:

C403.3.2 HVAC equipment performance requirements (Mandatory). Equipment shall meet the minimum efficiency requirements of Tables ~~C403.3.2(1) through C403.3.2(9)~~ 6.8.1-1 through 6.8.1-19 of ASHRAE Standard 90.1 when tested and rated in accordance with the applicable test procedure. Plate-type liquid-to-liquid heat exchangers shall meet the minimum requirements of Table ~~C403.3.2(10)~~ 6.8.1-8 of ASHRAE Standard 90.1. The efficiency shall be verified through certification under an approved certification program or, where a certification program does not exist, the equipment efficiency ratings shall be supported by data furnished by the manufacturer. Where multiple rating conditions or performance requirements are provided, the equipment shall satisfy all stated requirements. Where components, such as indoor or outdoor coils, from different manufacturers are used, calculations and supporting data shall be furnished by the designer that demonstrates that the combined efficiency of the specified components meets the requirements herein. Table 6.8.1-1 Electrically Operated Unitary Air Conditioners and Condensing Units - Minimum Efficiency Requirements

Table 6.8.1-2 Electrically Operated Air Cooled Unitary and Heat Pumps - Minimum Efficiency Requirements

Table 6.8.1-3 Water Chilling Packages - Minimum Efficiency Requirements

Table 6.8.1-4 Electrically Operated Packaged Terminal Air Conditioners, Packaged Terminal Heat Pumps, Single-Package Vertical Air Conditioners, Single-Package Vertical Heat Pumps, Room Air Conditioners, and Room Air Conditioner Heat Pumps—Minimum Efficiency Requirements

Table 6.8.1-5 Warm-Air Furnaces and Combination Warm-Air Furnaces/Air-Conditioning Units, Warm-Air Duct Furnaces, and Unit Heaters—Minimum Efficiency Requirements

Table 6.8.1-6 Gas- and Oil-Fired Boilers—Minimum Efficiency Requirements

Table 6.8.1-7 Performance Requirements for Heat Rejection Equipment—Minimum Efficiency Requirements

Table 6.8.1-8 Heat Transfer Equipment—Minimum Efficiency Requirements

Table 6.8.1-9 Electrically Operated Variable-Refrigerant-Flow Air Conditioners—Minimum Efficiency Requirements

Table 6.8.1-10 Electrically Operated Variable-Refrigerant-Flow and Applied Heat Pumps— Minimum Efficiency Requirements[if supportFields]> FILENAME

Table 6.8.1-11 Floor Mounted Air Conditioners and Condensing Units Serving Computer Rooms—Minimum Efficiency Requirements

Table 6.8.1-13 Commercial Refrigerators, Freezers and Refrigeration—Minimum Efficiency Requirements

Table 6.8.1-14 Vapor Compression Based Indoor Pool Dehumidifiers—Minimum Efficiency Requirements

Table 6.8.1-15 Electrically Operated DX-DOAS Units, Single-Package and Remote Condenser, without Energy Recovery—Minimum Efficiency Requirements

Table 6.8.1-16 Electrically Operated DX-DOAS Units, Single-Package and Remote Condenser, with Energy Recovery—Minimum Efficiency Requirements

Table 6.8.1-17 Electrically Operated Water Source Heat Pumps—Minimum Efficiency Requirements

Table 6.8.1-18 Heat Pump and Heat Reclaim Chiller Packages – Minimum Efficiency Requirements

Table 6.8.1-19 Ceiling Mounted Computer Room Air Conditioners—Minimum Efficiency Requirements

Delete without substitution:

TABLE C403.3.2(1)

MINIMUM EFFICIENCY REQUIREMENTS: ELECTRICALLY OPERATED UNITARY AIR CONDITIONERS AND CONDENSING UNITS

EQUIPMENT TYPE	SIZE CATEGORY	HEATING SECTION TYPE	SUBCATEGORY OR RATING CONDITION	MINIMUM EFFICIENCY	TEST PROCEDURE ^a
Air conditioners, air cooled	< 65,000 Btu/h ^b	All	Split System	13.0 SEER	AHRI 210/240
			Single Package	14.0 SEER	
Through-the-wall (air-cooled)	≤ 30,000 Btu/h ^b	All	Split system	12.0 SEER	
			Single Package	12.0 SEER	
Small-duct high-velocity (air-cooled)	< 65,000 Btu/h ^b	All	Split System	11.0 SEER	
Air conditioners, air cooled	≥ 65,000 Btu/h and < 135,000 Btu/h	Electric Resistance (or None)	Split System and Single Package	11.2 EER12.8 IEER	AHRI 340/360
		All other	Split System and Single Package	11.0 EER12.6 IEER	
	≥ 135,000 Btu/h and < 240,000 Btu/h	Electric Resistance (or None)	Split System and Single Package	11.0 EER12.4 IEER	
		All other	Split System and Single Package	10.8 EER12.2 IEER	
	≥ 240,000 Btu/h and < 760,000 Btu/h	Electric Resistance (or None)	Split System and Single Package	10.0 EER11.6 IEER	
		All other	Split System and Single Package	9.8 EER11.4 IEER	

	$\geq 760,000$ Btu/h	Electric Resistance (or None)	Split System and Single Package	9.7 EER11.2 IEER	
		All other	Split System and Single Package	9.5 EER11.0 IEER	
Air conditioners, water-cooled	$< 65,000$ Btu/h ^b	All	Split System and Single Package	12.1 EER12.3 IEER	AHRI 210/240
	$\geq 65,000$ Btu/h and $< 135,000$ Btu/h	Electric Resistance (or None)	Split System and Single Package	12.1 EER13.9 IEER	AHRI 340/360
		All other	Split System and Single Package	11.9 EER13.7 IEER	
	$\geq 135,000$ Btu/h and $< 240,000$ Btu/h	Electric Resistance (or None)	Split System and Single Package	12.5 EER13.9 IEER	
		All other	Split System and Single Package	12.3 EER13.7 IEER	
	$\geq 240,000$ Btu/h and $< 760,000$ Btu/h	Electric Resistance (or None)	Split System and Single Package	12.4 EER13.6 IEER	
		All other	Split System and Single Package	12.2 EER13.4 IEER	
	$\geq 760,000$ Btu/h	Electric Resistance (or None)	Split System and Single Package	12.2 EER13.5 IEER	
		All other	Split System and Single Package	12.0 EER13.3 IEER	
	$< 65,000$ Btu/h ^b	All	Split System and Single Package	12.1 EER12.3 IEER	AHRI 210/240
	$\geq 65,000$ Btu/h and $< 135,000$ Btu/h	Electric Resistance (or None)	Split System and Single Package	12.1 EER12.3 IEER	AHRI 340/360
		All other	Split System and Single Package	11.9 EER12.1 IEER	
Air conditioners, evaporatively-cooled	$\geq 135,000$ Btu/h and $< 240,000$ Btu/h	Electric Resistance (or None)	Split System and Single Package	12.0 EER12.2 IEER	
		All other	Split System and Single Package	11.8 EER12.0 IEER	

	$\geq 240,000$ Btu/h and $< 760,000$ Btu/h	Electric Resistance (or None)	Split System and Single Package	11.9 EER12.1 IEER	
		All other	Split System and Single Package	11.7 EER11.9 IEER	
	$\geq 760,000$ Btu/h	Electric Resistance (or None)	Split System and Single Package	11.7 EER11.9 IEER	
		All other	Split System and Single Package	11.5 EER11.7 IEER	
Condensing units, air-cooled	$\geq 135,000$ Btu/h	—	—	10.5 EER11.8 IEER	AHRI-365
Condensing units, water-cooled	$\geq 135,000$ Btu/h	—	—	13.5 EER14.0 IEER	
Condensing units, evaporatively-cooled	$\geq 135,000$ Btu/h	—	—	13.5 EER14.0 IEER	

For SI: 1 British thermal unit per hour = 0.2931 W.

- a. ~~Chapter 6 contains a complete specification of the referenced test procedure, including the reference year version of the test procedure.~~
- b. ~~Single phase, air-cooled air conditioners less than 65,000 Btu/h are regulated by NAECA. SEER values are those set by NAECA.~~

TABLE C403.3.2(2)
MINIMUM EFFICIENCY REQUIREMENTS: ELECTRICALLY OPERATED UNITARY AND APPLIED HEAT PUMPS

EQUIPMENT TYPE	SIZE CATEGORY	HEATING SECTION TYPE	SUBCATEGORY OR RATING CONDITION	MINIMUM EFFICIENCY	TEST PROCEDURE ^a
Air-cooled (cooling mode)	$< 65,000$ Btu/h ^b	All	Split System	14.0 SEER	AHRI-210/240
			Single Package	14.0 SEER	
Through-the-wall, air cooled	$\leq 30,000$ Btu/h ^b	All	Split System	12.0 SEER	
			Single Package	12.0 SEER	
Single-duct high-velocity air-cooled	$< 65,000$ Btu/h ^b	All	Split System	11.0 SEER	
	$\geq 65,000$ Btu/h and $< 135,000$ Btu/h	Electric Resistance (or None)	Split System and Single Package	11.0 EER 12.0 IEER	
		All other	Split System and Single Package	10.8 EER 11.8 IEER	

Air-cooled (cooling mode)	$\geq 135,000$ Btu/h and $\leq 240,000$ Btu/h	Electric Resistance (or None)	Split System and Single Package	10.6 EER 11.6 IEER	AHRI 340/360
		All other	Split System and Single Package	10.4 EER 11.4 IEER	
	$\geq 240,000$ Btu/h	Electric Resistance (or None)	Split System and Single Package	9.5 EER 10.6 IEER	
		All other	Split System and Single Package	9.3 EER-9.4 IEER	
Water to Air: Water Loop (cooling mode)	$< 17,000$ Btu/h	All	86°F entering water	12.2 EER	ISO 13256-1
	$\geq 17,000$ Btu/h and $\leq 65,000$ Btu/h	All	86°F entering water	13.0 EER	
	$\geq 65,000$ Btu/h and $\leq 135,000$ Btu/h	All	86°F entering water	13.0 EER	
Water to Air: Ground Water (cooling mode)	$< 135,000$ Btu/h	All	59°F entering water	18.0 EER	ISO 13256-1
Brine to Air: Ground Loop (cooling mode)	$< 135,000$ Btu/h	All	77°F entering water	14.1 EER	ISO 13256-1
Water to Water: Water Loop (cooling mode)	$< 135,000$ Btu/h	All	86°F entering water	10.6 EER	ISO 13256-2
Water to Water: Ground Water (cooling mode)	$< 135,000$ Btu/h	All	59°F entering water	16.3 EER	
Brine to Water: Ground Loop (cooling mode)	$< 135,000$ Btu/h	All	77°F entering fluid	12.1 EER	
Air-cooled (heating mode)	$< 65,000$ Btu/h ^b	—	Split System	8.2 HSPF	AHRI 210/240
		—	Single Package	8.0 HSPF	
Through-the-wall, (air cooled, heating mode)	$\leq 30,000$ Btu/h ^b (cooling capacity)	—	Split System	7.4 HSPF	
		—	Single Package	7.4 HSPF	
Small-duct high velocity (air cooled, heating mode)	$< 65,000$ Btu/h ^b	—	Split System	6.8 HSPF	
Air-cooled (heating mode)	$\geq 65,000$ Btu/h and $\leq 135,000$ Btu/h (cooling capacity)	—	47°F db/43°F wb outdoor air	3.3 COP	AHRI 340/360
			17°F db/15°F wb outdoor air	2.25 COP	
	$\geq 135,000$ Btu/h (cooling capacity)	—	47°F db/43°F wb outdoor air	3.2 COP	
			17°F db/15°F wb outdoor air	2.05 COP	
Water to Air: Water Loop (heating mode)	$< 135,000$ Btu/h (cooling capacity)	—	68°F entering water	4.3 COP	

Water to Air: Ground Water (heating mode)	<135,000 Btu/h (cooling capacity)	—	50°F entering water	3.7 COP	ISO 13256-1
Brine to Air: Ground Loop (heating mode)	<135,000 Btu/h (cooling capacity)	—	32°F entering fluid	3.2 COP	
Water to Water: Water Loop (heating mode)	<135,000 Btu/h (cooling capacity)	—	68°F entering water	3.7 COP	ISO 13256-2
Water to Water: Ground Water (heating mode)	<135,000 Btu/h (cooling capacity)	—	50°F entering water	3.1 COP	
Brine to Water: Ground Loop (heating mode)	<135,000 Btu/h (cooling capacity)	—	32°F entering fluid	2.5 COP	

For SI: 1 British thermal unit per hour = 0.2931 W, °C = [(°F) – 32]/1.8.

- a. ~~Chapter 6 contains a complete specification of the referenced test procedure, including the reference year version of the test procedure.~~
- b. Single-phase, air-cooled heat pumps less than 65,000 Btu/h are regulated by NAECA. SEER and HSPF values are those set by NAECA.

TABLE C403.3.2(3)

MINIMUM EFFICIENCY REQUIREMENTS: ELECTRICALLY OPERATED PACKAGED TERMINAL AIR CONDITIONERS, PACKAGED TERMINAL HEAT PUMPS, SINGLE-PACKAGE VERTICAL AIR CONDITIONERS, SINGLE VERTICAL HEAT PUMPS, ROOM AIR CONDITIONERS AND ROOM AIR-CONDITIONER HEAT PUMPS

EQUIPMENT TYPE	SIZE CATEGORY (INPUT)	SUBCATEGORY OR RATING CONDITION	MINIMUM EFFICIENCY	TEST PROCEDURE ^a
PTAC (cooling mode) new construction	All Capacities	95°F db outdoor air	14.0 – (0.300 × Cap/1000) EER	AHRI 310/380
PTAC (cooling mode) replacements ^b	All Capacities	95°F db outdoor air	10.9 – (0.213 × Cap/1000) EER	
PTHP (cooling mode) new construction	All Capacities	95°F db outdoor air	14.0 – (0.300 × Cap/1000) EER	
PTHP (cooling mode) replacements ^b	All Capacities	95°F db outdoor air	10.8 – (0.213 × Cap/1000) EER	
PTHP (heating mode) new construction	All Capacities	—	3.2 – (0.026 × Cap/1000) COP	
PTHP (heating mode) replacements ^b	All Capacities	—	2.9 – (0.026 × Cap/1000) COP	
SPVAC (cooling mode)	<65,000 Btu/h	95°F db/ 75°F wb outdoor air	9.0 EER	AHRI 300
	≥ 65,000 Btu/h and < 135,000 Btu/h	95°F db/ 75°F wb outdoor air	8.9 EER	
	≥ 135,000 Btu/h and < 240,000 Btu/h	95°F db/ 75°F wb outdoor air	8.6 EER	

SPVHP (cooling mode)	<65,000 Btu/h	95°F db/ 75°F wb outdoor air	9.0 EER	
	≥ 65,000 Btu/h and < 135,000 Btu/h	95°F db/ 75°F wb outdoor air	8.9 EER	
	≥ 135,000 Btu/h and < 240,000 Btu/h	95°F db/ 75°F wb outdoor air	8.6 EER	
SPVHP (heating mode)	<65,000 Btu/h	47°F db/ 43°F wb outdoor air	3.0 COP	AHRI-390
	≥ 65,000 Btu/h and < 135,000 Btu/h	47°F db/ 43°F wb outdoor air	3.0 COP	
	≥ 135,000 Btu/h and < 240,000 Btu/h	47°F db/ 75°F wb outdoor air	2.9 COP	
Room air conditioners, with louvered sides	<6,000 Btu/h	—	11.0 CEER	ANSI/AHAM RAG-1
	≥ 6,000 Btu/h and < 8,000 Btu/h	—	11.0 CEER	
	≥ 8,000 Btu/h and < 14,000 Btu/h	—	10.9 CEER	
	≥ 14,000 Btu/h and < 20,000 Btu/h	—	10.7 CEER	
	≥ 20,000 Btu/h and ≤ 25,000 Btu/h	—	9.4 CEER	
	> 25,000 Btu/h	—	9.0 CEER	
Room air conditioners, without louvered sides	<6,000 Btu/h	—	10.0 CEER	
	≥ 6,000 Btu/h and < 8,000 Btu/h	—	10.0 CEER	
	≥ 8,000 Btu/h and < 11,000 Btu/h	—	9.6 CEER	
	≥ 11,000 Btu/h and < 14,000 Btu/h	—	9.5 CEER	
	≥ 14,000 Btu/h and < 20,000 Btu/h	—	9.3 CEER	
	≥ 20,000 Btu/h	—	9.4 CEER	
Room air-conditioner heat pumps with louvered sides	< 20,000 Btu/h	—	9.8 CEER	
	≥ 20,000 Btu/h	—	9.3 CEER	
Room air-conditioner heat pumps without louvered sides	< 14,000 Btu/h	—	9.3 CEER	
	≥ 14,000 Btu/h	—	8.7 CEER	
Room air conditioner easement only	All capacities	—	9.5 CEER	ANSI/AHAM RAG-1
Room air conditioner easement slider	All capacities	—	10.4 CEER	

For SI: 1 British thermal unit per hour = 0.2931 W, °C = [(°F) - 32]/1.8, wb = wet bulb, db = dry bulb.

“Cap” = The rated cooling capacity of the project in Btu/h. Where the unit’s capacity is less than 7000 Btu/h, use 7000 Btu/h in the calculation. Where the unit’s capacity is greater than 15,000 Btu/h, use 15,000 Btu/h in the

calculations:

- a. ~~Chapter 6 contains a complete specification of the referenced test procedure, including the referenced year version of the test procedure.~~
- b. Replacement unit shall be factory labeled as follows: "MANUFACTURED FOR REPLACEMENT APPLICATIONS ONLY: NOT TO BE INSTALLED IN NEW CONSTRUCTION PROJECTS."
Replacement efficiencies apply only to units with existing sleeves less than 16 inches (406 mm) in height and less than 42 inches (1067 mm) in width.

TABLE C403.3.2(4)

~~WARM-AIR FURNACES AND COMBINATION WARM-AIR FURNACES/AIR-CONDITIONING UNITS, WARM-AIR DUCT FURNACES AND UNIT HEATERS, MINIMUM EFFICIENCY REQUIREMENTS~~

EQUIPMENT TYPE	SIZE CATEGORY (INPUT)	SUBCATEGORY OR RATING CONDITION	MINIMUM EFFICIENCY ^{d, e}	TEST PROCEDURE ^a
Warm-air furnaces, gas fired	< 225,000 Btu/h	—	80% AFUE or 80% E_t^e	DOE 10 GFR Part 430 or ANSI Z21.47
	≥ 225,000 Btu/h	Maximum capacity ^e	80% E_t^f	ANSI Z21.47
Warm-air furnaces, oil fired	< 225,000 Btu/h	—	83% AFUE or 80% E_t^e	DOE 10 GFR Part 430 or UL 727
	≥ 225,000 Btu/h	Maximum capacity ^b	81% E_t^g	UL 727
Warm-air duct furnaces, gas fired	All capacities	Maximum capacity ^b	80% E_e	ANSI Z83.8
Warm-air unit heaters, gas fired	All capacities	Maximum capacity ^b	80% E_e	ANSI Z83.8
Warm-air unit heaters, oil fired	All capacities	Maximum capacity ^b	80% E_e	UL 731

For SI: 1 British thermal unit per hour = 0.2931 W.

- a. ~~Chapter 6 contains a complete specification of the referenced test procedure, including the referenced year version of the test procedure.~~
- b. ~~Minimum and maximum ratings as provided for and allowed by the unit's controls.~~
- c. ~~Combination units not covered by the National Appliance Energy Conservation Act of 1987 (NAECA) (3-phase power or cooling capacity greater than or equal to 65,000 Btu/h [19 kW]) shall comply with either rating.~~
- d. ~~E_t = Thermal efficiency. See test procedure for detailed discussion.~~
- e. ~~E_e = Combustion efficiency (100% less flue losses). See test procedure for detailed discussion.~~
- f. ~~E_c = Combustion efficiency. Units shall also include an IID, have jackets not exceeding 0.75 percent of the input rating, and have either power venting or a flue damper. A vent damper is an acceptable alternative to a flue damper for those furnaces where combustion air is drawn from the conditioned space.~~
- g. ~~E_t = Thermal efficiency. Units shall also include an IID, have jacket losses not exceeding 0.75 percent of the input rating, and have either power venting or a flue damper. A vent damper is an acceptable alternative to a flue damper for those furnaces where combustion air is drawn from the conditioned space.~~

TABLE C403.3.2(5)
MINIMUM EFFICIENCY REQUIREMENTS: GAS AND OIL-FIRED BOILERS

EQUIPMENT TYPE ^a	SUBCATEGORY OR RATING CONDITION	SIZE CATEGORY (INPUT)	MINIMUM EFFICIENCY ^{d,e}	TEST PROCEDURE
Boilers, hot water	Gas-fired	< 300,000 Btu/h ^{f,g}	82% AFUE	10 CFR Part 430
		≥ 300,000 Btu/h and ≤ 2,500,000 Btu/h ^b	80% E_t	10 CFR Part 431
		> 2,500,000 Btu/h ^a	82% E_e	
	Oil-fired ^e	< 300,000 Btu/h ^g	84% AFUE	10 CFR Part 430
		≥ 300,000 Btu/h and ≤ 2,500,000 Btu/h ^b	82% E_t	10 CFR Part 431
		> 2,500,000 Btu/h ^a	84% E_e	
Boilers, steam	Gas-fired	< 300,000 Btu/h ^f	80% AFUE	10 CFR Part 430
	Gas-fired— all, except natural draft	≥ 300,000 Btu/h and ≤ 2,500,000 Btu/h ^b	79% E_t	10 CFR Part 431
		> 2,500,000 Btu/h ^a	79% E_t	
	Gas-fired— natural draft	≥ 300,000 Btu/h and ≤ 2,500,000 Btu/h ^b	77% E_t	
		> 2,500,000 Btu/h ^a	77% E_t	
	Oil-fired ^e	< 300,000 Btu/h	82% AFUE	10 CFR Part 430
		≥ 300,000 Btu/h and ≤ 2,500,000 Btu/h ^b	81% E_t	10 CFR Part 431
		> 2,500,000 Btu/h ^a	81% E_t	

For SI: 1 British thermal unit per hour = 0.2931 W.

- a. These requirements apply to boilers with rated input of 8,000,000 Btu/h or less that are not packaged boilers and to all packaged boilers. Minimum efficiency requirements for boilers cover all capacities of packaged boilers.
- b. Maximum capacity — minimum and maximum ratings as provided for and allowed by the unit's controls.
- c. Includes oil-fired (residual).
- d. E_e = Combustion efficiency (100 percent less flue losses).
- e. E_t = Thermal efficiency. See referenced standard for detailed information.
- f. Boilers shall not be equipped with a constant burning ignition pilot.
- g. A boiler not equipped with a tankless domestic water heating coil shall be equipped with an automatic means for adjusting the temperature of the water such that an incremental change in inferred heat load produces a corresponding incremental change in the temperature of the water supplied.

TABLE C403.3.2(6)
MINIMUM EFFICIENCY REQUIREMENTS: CONDENSING UNITS, ELECTRICALLY OPERATED

EQUIPMENT TYPE	SIZE CATEGORY	MINIMUM EFFICIENCY ^b	TEST PROCEDURE ^a
Condensing units, air cooled	≥ 135,000 Btu/h	10.1 EER/11.2 IPLV	AHRI 365
Condensing units, water or evaporatively cooled	≥ 135,000 Btu/h	13.1 EER/13.1 IPLV	

For SI: 1 British thermal unit per hour = 0.2931 W.

- a. Chapter 6 contains a complete specification of the referenced test procedure, including the referenced year version of the test procedure.
- b. IPLVs are only applicable to equipment with capacity modulation.

TABLE C403.3.2(7)
WATER CHILLING PACKAGES — EFFICIENCY REQUIREMENTS^{a, b, d}

EQUIPMENT TYPE	SIZE CATEGORY	UNITS	BEFORE 1/1/2015		AS OF 1/1/2015		TEST PROCEDURE ^e	
			Path A	Path B	Path A	Path B		
Air-cooled chillers	< 150 Tons	EER (Btu/W)	≥ 9.562 FL	NA ^e	≥ 10.100 FL	≥ 9.700 FL		
			≥ 12.500 IPLV		≥ 13.700 IPLV	≥ 15.800 IPLV		
	≥ 150 Tons		≥ 9.562 FL	NA ^e	≥ 10.100 FL	≥ 9.700 FL		
			≥ 12.500 IPLV		≥ 14.000 IPLV	≥ 16.100 IPLV		
Air-cooled without condenser, electrically operated	All capacities	EER(Btu/W)	Air-cooled chillers without condenser shall be rated with matching condensers and complying with air-cooled chiller efficiency requirements.					
Water-cooled, electrically operated positive displacement	< 75 Tons	kW/ton	≤ 0.780 FL	≤ 0.800 FL	≤ 0.750 FL	≤ 0.780 FL		AHRI 550/590
			≤ 0.630 IPLV	≤ 0.600 IPLV	≤ 0.600 IPLV	≤ 0.500 IPLV		
	≥ 75 tons and < 150 tons		≤ 0.775 FL	≤ 0.790 FL	≤ 0.720 FL	≤ 0.750 FL		
			≤ 0.615 IPLV	≤ 0.586 IPLV	≤ 0.560 IPLV	≤ 0.490 IPLV		
	≥ 150 tons and < 300 tons		≥ 0.680 FL	≥ 0.718 FL	≥ 0.660 FL	≥ 0.680 FL		
			≥ 0.580 IPLV	≥ 0.540 IPLV	≥ 0.540 IPLV	≥ 0.440 IPLV		
	≥ 300 tons and < 600 tons		≤ 0.620 FL	≤ 0.639 FL	≤ 0.610 FL	≤ 0.625 FL		
			≤ 0.540 IPLV	≤ 0.490 IPLV	≤ 0.520 IPLV	≤ 0.410 IPLV		
> 600 tons	≤ 0.620 FL	≤ 0.639 FL	≤ 0.560 FL	≤ 0.585 FL				

	≤ 600 tons		≤0.540 IPLV	≤0.490 IPLV	≤0.500 IPLV	≤0.380 IPLV	
Water-cooled, electrically-operated centrifugal	< 150 Tons	kW/ton	≤0.634 FL	≤0.639 FL	≤0.610 FL	≤0.695 FL	
			≤0.596 IPLV	≤0.450 IPLV	≤0.550 IPLV	≤0.440 IPLV	
	≥ 150 tons and < 300 tons		≤0.634 FL	≤0.639 FL	≤0.610 FL	≤0.635 FL	
			≤0.596 IPLV	≤0.450 IPLV	≤0.550 IPLV	≤0.400 IPLV	
	≥ 300 tons and < 400 tons		≤0.576 FL	≤0.600 FL	≤0.560 FL	≤0.595 FL	
			≤0.549 IPLV	≤0.400 IPLV	≤0.520 IPLV	≤0.390 IPLV	
	≥ 400 tons and < 600 tons		≤0.576 FL	≤0.600 FL	≤0.560 FL	≤0.585 FL	
			≤0.549 IPLV	≤0.400 IPLV	≤0.500 IPLV	≤0.380 IPLV	
	≥ 600 Tons		≤0.570 FL	≤0.590 FL	≤0.560 FL	≤0.585 FL	
≤0.539 IPLV		≤0.400 IPLV	≤0.500 IPLV	≤0.380 IPLV			
Air-cooled, absorption, single effect	All capacities	GOP	≥ 0.600 FL	NA ^e	≥ 0.600 FL	NA ^e	AHRI-560
Water-cooled absorption, single effect	All capacities	GOP	≥ 0.700 FL	NA ^e	≥ 0.700 FL	NA ^e	
Absorption, double effect, indirect-fired	All capacities	GOP	≥ 1.000 FL	NA ^e	≥ 1.000 FL	NA ^e	
			≥ 1.050 IPLV		≥ 1.050 IPLV		
Absorption double effect direct-fired	All capacities	GOP	≥ 1.000 FL	NA ^e	≥ 1.000 FL	NA ^e	
			≥ 1.000 IPLV		≥ 1.050 IPLV		

- a. The requirements for centrifugal chiller shall be adjusted for nonstandard rating conditions in accordance with Section G403.3.2.1 and are only applicable for the range of conditions listed in Section G403.3.2.1. The requirements for air-cooled, water-cooled positive displacement and absorption chillers are at standard rating conditions defined in the reference test procedure.
- b. Both the full load and IPLV requirements shall be met or exceeded to comply with this standard. Where there is a Path B, compliance can be with either Path A or Path B for any application.
- c. NA means the requirements are not applicable for Path B and only Path A can be used for compliance.
- d. FL represents the full load performance requirements and IPLV the part load performance requirements.

TABLE C403.3.2(8)
MINIMUM EFFICIENCY REQUIREMENTS: HEAT REJECTION EQUIPMENT

EQUIPMENT TYPE^a	TOTAL SYSTEM HEAT REJECTION CAPACITY AT RATED CONDITIONS	SUBCATEGORY OR RATING CONDITIONⁱ	PERFORMANCE REQUIRED^{b, c, d, g, h}	TEST PROCEDURE^{e, f}
Propeller or axial fan open-circuit cooling towers	All	95°F entering water 85°F leaving water 75°F entering wb	≥ 40.2 gpm/hp	GTI ATC-105 and GTI STD-201 RS
Gentrifugal fan open-circuit cooling towers	All	95°F entering water 85°F leaving water 75°F entering wb	≥ 20.0 gpm/hp	GTI ATC-105 and GTI STD-201 RS
Propeller or axial fan closed-circuit cooling towers	All	102°F entering water 90°F leaving water 75°F entering wb	≥ 16.1 gpm/hp	GTI ATC-105S and GTI STD-201 RS
Gentrifugal fan closed-circuit cooling towers	All	102°F entering water 90°F leaving water 75°F entering wb	≥ 7.0 gpm/hp	GTI ATC-105S and GTI STD-201 RS
Propeller or axial fan evaporative condensers	All	Ammonia Test Fluid 140°F entering gas temperature 96.3°F condensing temperature 75°F entering wb	≥ 134,000 Btu/h x hp	GTI ATC-106
Gentrifugal fan evaporative condensers	All	Ammonia Test Fluid 140°F entering gas temperature 96.3°F condensing temperature 75°F entering wb	≥ 110,000 Btu/h x hp	GTI ATC-106
Propeller or axial fan evaporative condensers	All	R-507A Test Fluid 165°F entering gas temperature 105°F condensing temperature 75°F entering wb	≥ 157,000 Btu/h x hp	GTI ATC-106
Gentrifugal fan evaporative condensers	All	R-507A Test Fluid 165°F entering gas temperature 105°F condensing temperature 75°F entering wb	≥ 135,000 Btu/h x hp	GTI ATC-106
Air-cooled condensers	All	125°F Condensing Temperature 190°F Entering Gas Temperature 15°F subcooling 95°F entering db	≥ 176,000 Btu/h x hp	AHRI-460

For SI: °C = [(°F) - 32]/1.8, L/s • kW = (gpm/hp)/(11.83), COP = (Btu/h • hp)/(2550.7),

db = dry bulb temperature, °F, wb = wet bulb temperature, °F.

- a. The efficiencies and test procedures for both open and closed-circuit cooling towers are not applicable to hybrid cooling towers that contain a combination of wet and dry heat exchange

- sections-
- b. ~~For purposes of this table, open circuit cooling tower performance is defined as the water flow rating of the tower at the thermal rating condition, divided by the fan nameplate-rated motor power.~~
 - e. ~~For purposes of this table, closed circuit cooling tower performance is defined as the water flow rating of the tower at the thermal rating condition, divided by the sum of the fan nameplate-rated motor power and the spray pump nameplate-rated motor power.~~
 - d. ~~For purposes of this table, air-cooled condenser performance is defined as the heat rejected from the refrigerant divided by the fan nameplate-rated motor power.~~
 - e. ~~Chapter 6 contains a complete specification of the referenced test procedure, including the referenced year version of the test procedure. The certification requirements do not apply to field-erected cooling towers.~~
 - f. ~~Where a certification program exists for a covered product and it includes provisions for verification and challenge of equipment efficiency ratings, then the product shall be listed in the certification program; or, where a certification program exists for a covered product, and it includes provisions for verification and challenge of equipment efficiency ratings, but the product is not listed in the existing certification program, the ratings shall be verified by an independent laboratory test report.~~
 - g. ~~Cooling towers shall comply with the minimum efficiency listed in the table for that specific type of tower with the capacity effect of any project-specific accessories or options included in the capacity of the cooling tower~~
 - h. ~~For purposes of this table, evaporative condenser performance is defined as the heat rejected at the specified rating condition in the table divided by the sum of the fan motor nameplate power and the integral spray pump nameplate power~~
 - i. ~~Requirements for evaporative condensers are listed with ammonia (R-717) and R-507A as test fluids in the table. Evaporative condensers intended for use with halocarbon refrigerants other than R-507A shall meet the minimum efficiency requirements listed in this table with R-507A as the test fluid.~~

TABLE C403.3.2(9)

MINIMUM EFFICIENCY AIR CONDITIONERS AND CONDENSING UNITS SERVING COMPUTER ROOMS

EQUIPMENT TYPE	NET SENSIBLE COOLING CAPACITY^a	MINIMUM SCOP-127^b EFFICIENCY DOWNFLOW UNITS / UPFLOW UNITS	TEST PROCEDURE
Air conditioners, air-cooled	< 65,000 Btu/h	2.20 / 2.09	
	≥ 65,000 Btu/h and < 240,000 Btu/h	2.10 / 1.99	
	≥ 240,000 Btu/h	1.90 / 1.79	
Air conditioners, water-cooled	< 65,000 Btu/h	2.60 / 2.49	
	≥ 65,000 Btu/h and < 240,000 Btu/h	2.50 / 2.39	
	≥ 240,000 Btu/h	2.40 / 2.29	
Air conditioners, water-cooled with fluid	< 65,000 Btu/h	2.55 / 2.44	ANSI/ASHRAE
	≥ 65,000 Btu/h and < 240,000 Btu/h	2.45 / 2.34	

economizer			127
	$\geq 240,000$ Btu/h	2.35 / 2.24	
	$< 65,000$ Btu/h	2.50 / 2.39	
Air conditioners, glycol-cooled (rated at 40% propylene glycol)	$\geq 65,000$ Btu/h and $< 240,000$ Btu/h	2.15 / 2.04	
	$\geq 240,000$ Btu/h	2.10 / 1.99	
Air conditioners, glycol-cooled (rated at 40% propylene glycol) with fluid economizer	$< 65,000$ Btu/h	2.45 / 2.34	
	$\geq 65,000$ Btu/h and $< 240,000$ Btu/h	2.10 / 1.99	
	$\geq 240,000$ Btu/h	2.05 / 1.94	

For SI: 1 British thermal unit per hour = 0.2931 W.

- a. Net sensible cooling capacity: the total gross cooling capacity less the latent cooling less the energy to the air movement system. (Total Gross — latent — Fan Power).
- b. Sensible coefficient of performance (SCOP-127): a ratio calculated by dividing the net sensible cooling capacity in watts by the total power input in watts (excluding reheaters and humidifiers) at conditions defined in ASHRAE Standard 127. The net sensible cooling capacity is the gross sensible capacity minus the energy dissipated into the cooled space by the fan system.

TABLE C403.3.2(10)
HEAT TRANSFER EQUIPMENT

EQUIPMENT TYPE	SUBCATEGORY	MINIMUM EFFICIENCY	TEST PROCEDURE ^a
Liquid-to-liquid heat exchangers	Plate type	NR	AHRI 400

NR = No Requirement.

- a. Chapter 6 contains a complete specification of the referenced test procedure, including the referenced year version of the test procedure.

C403.3.2.1 Water-cooled centrifugal chilling packages (Mandatory). Equipment not designed for operation at AHRI Standard 550/590 test conditions of 44°F (7°C) leaving chilled-water temperature and 2.4 gpm/ton evaporator fluid flow and 85°F (29°C) entering condenser water temperature with 3 gpm/ton (0.054 l/s • kW) condenser water flow shall have maximum full-load kW/ton (FL) and part-load ratings requirements adjusted using Equations 4-6 and 4-7.

$$FL_{adj} = FL/K_{adj}$$

(Equation 4-6)

$$PLV_{adj} = IPLV/K_{adj}$$

(Equation 4-7)

where:

$$K_{adj} = A \times B$$

FL = Full-load kW/ton value as specified
in ~~Table C403.3.2(7)~~ the tables in Section C403.3.2.

FL_{adj} = Maximum full-load kW/ton rating, adjusted for nonstandard conditions.

$IPLV$ = Value as specified in ~~Table C403.3.2(7)~~ the tables in Section C403.3.2.

PLV_{adj} = Maximum $NPLV$ rating, adjusted for nonstandard conditions.

$$A = 0.00000014592 \times (LIFT)^4 + 0.0000346496 \times (LIFT)^3 + 0.00314196 \times (LIFT)^2 - 0.147199 \times (LIFT) + 3.9302$$

$$B = 0.0015 \times L_{vg}E_{vap} + 0.934$$

$$LIFT = L_{vg}Cond - L_{vg}E_{vap}$$

$L_{vg}Cond$ = Full-load condenser leaving fluid temperature ($^{\circ}F$).

$L_{vg}Evap$ = Full-load evaporator leaving temperature ($^{\circ}F$).

The FL_{adj} and PLV_{adj} values are only applicable for centrifugal chillers meeting all of the following full-load design ranges:

1. Minimum evaporator leaving temperature: $36^{\circ}F$.
2. Maximum condenser leaving temperature: $115^{\circ}F$.
3. $20^{\circ}F \leq LIFT \leq 80^{\circ}F$.

C403.3.2.2 Positive displacement (air- and water-cooled) chilling packages. Equipment with a leaving fluid temperature higher than $32^{\circ}F$ ($0^{\circ}C$) and water-cooled positive displacement chilling packages with a condenser leaving fluid temperature below $115^{\circ}F$ ($46^{\circ}C$) shall meet the requirements of ~~Table C403.3.2(7)~~ the tables in Section C403.3.2. when tested or certified with water at standard rating conditions, in accordance with the referenced test procedure.

C403.5.5 Economizer fault detection and diagnostics (Mandatory). Air-cooled unitary direct-expansion units listed in ~~Tables C403.3.2(1) through C403.3.2(3)~~ the tables in Section C403.3.2. and variable refrigerant flow (VRF) units that are equipped with an economizer in accordance with Sections C403.5 through C403.5.4 shall include a fault detection and diagnostics system complying with the following:

1. The following temperature sensors shall be permanently installed to monitor system operation:
 - 1.1. Outside air.
 - 1.2. Supply air.
 - 1.3. Return air.
2. Temperature sensors shall have an accuracy of $\pm 2^{\circ}F$ ($1.1^{\circ}C$) over the range of $40^{\circ}F$ to $80^{\circ}F$ ($4^{\circ}C$ to $26.7^{\circ}C$).
3. Refrigerant pressure sensors, where used, shall have an accuracy of ± 3 percent of full scale.
4. The unit controller shall be configured to provide system status by indicating the following:
 - 4.1. Free cooling available.
 - 4.2. Economizer enabled.
 - 4.3. Compressor enabled.
 - 4.4. Heating enabled.
 - 4.5. Mixed air low limit cycle active.
 - 4.6. The current value of each sensor.
5. The unit controller shall be capable of manually initiating each operating mode so that the operation of compressors, economizers, fans and the heating system can be independently

- tested and verified.
6. The unit shall be configured to report faults to a fault management application available for access by day-to-day operating or service personnel, or annunciated locally on zone thermostats.
 7. The fault detection and diagnostics system shall be configured to detect the following faults:
 - 7.1. Air temperature sensor failure/fault.
 - 7.2. Not economizing when the unit should be economizing.
 - 7.3. Economizing when the unit should not be economizing.
 - 7.4. Damper not modulating.
 - 7.5. Excess outdoor air.

C403.9 Heat rejection equipment. Heat rejection equipment, including air-cooled condensers, dry coolers, open-circuit cooling towers, closed-circuit cooling towers and evaporative condensers, shall comply with this section.

Exception: Heat rejection devices where energy usage is included in the equipment efficiency ratings listed in ~~Tables C403.3.2(6) and C403.3.2(7)~~ the tables in Section C403.3.2.

C406.2 More efficient HVAC equipment performance. Equipment shall exceed the minimum efficiency requirements listed in ~~Tables C403.3.2(1) through C403.3.2(7)~~ the tables in Section C403.3.2 by 10 percent, in addition to the requirements of Section C403. Where multiple performance requirements are provided, the equipment shall exceed all requirements by 10 percent. *Variable refrigerant flow systems* shall exceed the energy efficiency provisions of ANSI/ASHRAE/IESNA 90.1 by 10 percent. Equipment not listed in Tables C403.3.2(1) through C403.3.2(7) shall be limited to 10 percent of the total building system capacity.

TABLE C407.5.1(1)
SPECIFICATIONS FOR THE STANDARD REFERENCE AND PROPOSED DESIGNS

BUILDING COMPONENT CHARACTERISTICS	STANDARD REFERENCE DESIGN	PROPOSED DESIGN
Space use classification	Same as proposed	The space use classification shall be chosen in accordance with Table C405.5.2 for all areas of the building covered by this permit. Where the space use classification for a building is not known, the building shall be categorized as an office building.
Roofs	Type: Insulation entirely above deck	As proposed
	Gross area: same as proposed	As proposed
	U-factor: as specified in Table C402.1.4	As proposed
	Solar absorptance: 0.75	As proposed
	Emittance: 0.90	As proposed
Walls, above-grade	Type: Mass wall where proposed wall is mass; otherwise steel-framed wall	As proposed
	Gross area: same as proposed	As proposed
	U-factor: as specified in Table C402.1.4	As proposed

	Solar absorptance: 0.75	As proposed
	Emittance: 0.90	As proposed
Walls, below-grade	Type: Mass wall	As proposed
	Gross area: same as proposed	As proposed
	U-Factor: as specified in Table C402.1.4 with insulation layer on interiorside of walls	As proposed
Floors, above-grade	Type: joist/framed floor	As proposed
	Gross area: same as proposed	As proposed
	U-factor: as specified in Table C402.1.4	As proposed
Floors, slab-on-grade	Type: Unheated	As proposed
	F-factor: as specified in Table C402.1.4	As proposed
Opaque doors	Type: Swinging	As proposed
	Area: Same as proposed	As proposed
	U-factor: as specified in Table C402.1.4	As proposed
Vertical fenestration other than opaque doors	Area 1.The proposed vertical fenestration area; where the proposed vertical fenestration area is less than 40 percent of above-grade wall area. 2.40 percent of above-grade wall area; where the proposed vertical fenestration area is 40 percent or more of the above-grade wall area.	As proposed
	U-factor: as specified in Table C402.4	As proposed
	SHGC: as specified in Table C402.4 except that for climates with no requirement (NR) SHGC = 0.40 shall be used	As proposed
	External shading and PF: None	As proposed

Skylights	<p>Area</p> <p>1.The proposed skylight area; where the proposed skylight area is less than that permitted by Section C402.1.</p> <p>2.The area permitted by Section C402.1; where the proposed skylight area exceeds that permitted by Section C402.1</p>	As proposed
	<i>U</i> -factor: as specified in Table C402.4	As proposed
	SHGC: as specified in Table C402.4 except that for climates with no requirement (NR) SHGC = 0.40 shall be used.	As proposed
Lighting, interior	The interior lighting power shall be determined in accordance with Section C405.3.2. Where the occupancy of the building is not known, the lighting power density shall be 1.0 Watt per square foot (10.7 W/m ²) based on the categorization of buildings with unknown space classification as offices.	As proposed
Lighting, exterior	The lighting power shall be determined in accordance with Table C405.4.2(2) and C405.4.2(3). Areas and dimensions of surfaces shall be the same as proposed.	As proposed
Internal gains	Same as proposed	Receptacle, motor and process loads shall be modeled and estimated based on the space use classification. End-use load components within and associated with the building shall be modeled to include, but not be limited to, the following: exhaust fans, parking garage ventilation fans, exterior building lighting, swimming pool heaters and pumps, elevators, escalators, refrigeration equipment and cooking equipment.

Schedules	Same as proposed Exception: Thermostat settings and schedules for HVAC systems that utilize radiant heating, radiant cooling and elevated air speed, provided that equivalent levels of occupant thermal comfort are demonstrated by means of equal Standard Effective Temperature as calculated in Normative Appendix B of ASHRAE Standard 55.	Operating schedules shall include hourly profiles for daily operation and shall account for variations between weekdays, weekends, holidays and any seasonal operation. Schedules shall model the time-dependent variations in occupancy, illumination, receptacle loads, thermostat settings, mechanical ventilation, HVAC equipment availability, service hot water usage and any process loads. The schedules shall be typical of the proposed building type as determined by the designer and approved by the jurisdiction.
Mechanical ventilation	Same as proposed	As proposed, in accordance with Section C403.2.2.
Heating systems	Fuel type: same as proposed design	As proposed
	Equipment type ^a : as specified in Tables C407.5.1(2) and C407.5.1(3)	As proposed
	Efficiency: as specified in Tables C403.3.2(4) and C403.3.2(5) <u>the tables in Section C403.3.2.</u>	As proposed
	Capacity ^b : sized proportionally to the capacities in the proposed design based on sizing runs, and shall be established such that no smaller number of unmet heating load hours and no larger heating capacity safety factors are provided than in the proposed design.	As proposed
Cooling systems	Fuel type: same as proposed design	As proposed
	Equipment type ^c : as specified in Tables C407.5.1(2) and C407.5.1(3)	As proposed
	Efficiency: as specified in Tables C403.3.2(1), C403.3.2(2) and C403.3.2(3) <u>the tables in Section C403.3.2</u>	As proposed

	Capacity ^b : sized proportionally to the capacities in the proposed design based on sizing runs, and shall be established such that no smaller number of unmet cooling load hours and no larger cooling capacity safety factors are provided than in the proposed design.	As proposed
	Economizer ^d : same as proposed, in accordance with Section C403.5.	As proposed
Service water heating ^e	Fuel type: same as proposed	As proposed
	Efficiency: as specified in Table C404.2	For <i>Group R</i> , as proposed multiplied by SWHF. For other than <i>Group R</i> , as proposed multiplied by efficiency as provided by the manufacturer of the DWHR unit.
	Capacity: same as proposed	As proposed
	Where no service water hot water system exists or is specified in the proposed design, no service hot water heating shall be modeled.	

SWHF = Service water heat recovery factor, DWHR = Drain water heat recovery.

- a. Where no heating system exists or has been specified, the heating system shall be modeled as fossil fuel. The system characteristics shall be identical in both the standard reference design and proposed design.
- b. The ratio between the capacities used in the annual simulations and the capacities determined by sizing runs shall be the same for both the standard reference design and proposed design.
- c. Where no cooling system exists or no cooling system has been specified, the cooling system shall be modeled as an air-cooled single-zone system, one unit per thermal zone. The system characteristics shall be identical in both the standard reference design and proposed design.
- d. If an economizer is required in accordance with Table C403.5(1) and where no economizer exists or is specified in the proposed design, then a supply-air economizer shall be provided in the standard reference design in accordance with Section C403.5.
- e. The SWHF shall be applied as follows:
 1. Where potable water from the DWHR unit supplies not less than one shower and not greater than two showers, of which the drain water from the same showers flows through the DWHR unit then $SWHF = [1 - (DWHR \text{ unit efficiency} \cdot 0.36)]$.
 2. Where potable water from the DWHR unit supplies not less than three showers and not greater than four showers, of which the drain water from the same showers flows through the DWHR unit then $SWHF = [1 - (DWHR \text{ unit efficiency} \cdot 0.33)]$.
 3. Where potable water from the DWHR unit supplies not less than five showers and not greater than six showers, of which the drain water from the same showers flows through the DWHR unit, then $SWHF = [1 - (DWHR \text{ unit efficiency} \cdot 0.26)]$.
 4. Where Items 1 through 3 are not met, $SWHF = 1.0$.

C408.2.3.1 Equipment. Equipment functional performance testing shall demonstrate the installation and

operation of components, systems, and system-to-system interfacing relationships in accordance with approved plans and specifications such that operation, function, and maintenance serviceability for each of the commissioned systems is confirmed. Testing shall include all modes and *sequence of operation*, including under full-load, part-load and the following emergency conditions:

1. All modes as described in the *sequence of operation*.
2. Redundant or *automatic* back-up mode.
3. Performance of alarms.
4. Mode of operation upon a loss of power and restoration of power.

Exception: Unitary or packaged HVAC equipment listed in ~~Tables C403.3.2(1) through C403.3.2(3)~~ the tables in Section C403.3.2 that do not require supply air economizers.

Reason: *These tables have historically come from ASHRAE Standard 90.1. They all represent industry consensus, and are rarely, if ever, intended to be different than 90.1.*

During the last few code cycles, we have noticed that due to the processes, the tables tend to diverge. The reason for this is that public comments to the IECC are due before the final tables are developed and generated for 90.1. Typically, we find errata in the 90.1 tables when we are developing the print version of the standard. Due to timing, those corrections in 90.1 never make it into the IECC. By referencing these tables in 90.1, we ensure that the requirements are aligned. ASHRAE also recognizes that code officials want to have the tables in the book. If this proposal is accepted, ASHRAE has contacted ICC staff about the possibility of reprinting the necessary tables in the IECC as printed in 90.1.

This proposal intends to modify the code by extracting and reprinting the following Tables from ASHRAE Standard 90.1-2019:

Table 6.8.1-1 Electrically Operated Unitary Air Conditioners and Condensing Units—Minimum Efficiency Requirements

Table 6.8.1-2 Electrically Operated Air Cooled Unitary and Heat Pumps—Minimum Efficiency Requirements

Table 6.8.1-3 Water-Chilling Packages—Minimum Efficiency Requirements

Table 6.8.1-4 Electrically Operated Packaged Terminal Air Conditioners, Packaged Terminal Heat Pumps, Single-Package Vertical Air Conditioners, Single-Package Vertical Heat Pumps, Room Air Conditioners, and Room Air Conditioner Heat Pumps—Minimum Efficiency Requirements

Table 6.8.1-5 Warm-Air Furnaces and Combination Warm-

Air Furnaces/Air-Conditioning Units, Warm-Air Duct Furnaces, and Unit Heaters—Minimum *Efficiency* Requirements

Table 6.8.1-6 Gas- and Oil-Fired *Boilers*—Minimum *Efficiency* Requirements

Table 6.8.1-7 Performance Requirements for Heat Rejection Equipment—Minimum *Efficiency* Requirements

Table 6.8.1-8 Heat Transfer *Equipment*—Minimum *Efficiency* Requirements

Table 6.8.1-9 Electrically Operated Variable-Refrigerant-Flow Air Conditioners—Minimum *Efficiency* Requirements

Table 6.8.1-10 Electrically Operated Variable-Refrigerant-Flow and Applied Heat Pumps—Minimum *Efficiency* Requirements

Table 6.8.1-11 Floor Mounted Air Conditioners and *Condensing Units* Serving *Computer Rooms*—Minimum *Efficiency* Requirements

Table 6.8.1-13 Commercial Refrigerators, Freezers and Refrigeration—Minimum *Efficiency* Requirements

Table 6.8.1-14 Vapor Compression Based *Indoor Pool Dehumidifiers*—Minimum *Efficiency* Requirements

Table 6.8.1-15 Electrically Operated *DX-DOAS Units*, Single-Package and Remote Condenser, without *Energy* Recovery—Minimum *Efficiency* Requirements

Table 6.8.1-16 Electrically Operated *DX-DOAS Units*, Single-Package and Remote Condenser, with *Energy* Recovery—Minimum *Efficiency* Requirements

Table 6.8.1-17 Electrically Operated Water Source Heat

Pumps—Minimum *Efficiency* Requirements

Table 6.8.1-18 Heat Pump and Heat Reclaim Chiller Packages – Minimum Efficiency Requirements

Table 6.8.1-19 Ceiling Mounted Computer Room Air Conditioners—Minimum *Efficiency* Requirements

This proposal does add new tables for DOAS units, electrically operated water source heat pumps, heat pump and heat reclaim chiller packages, ceiling mounted computer room air conditioners, and commercial refrigerators and freezers that were previously not covered in the IECC.

The proposal includes six sections and a table which contain specific references to one or more individual tables in Section C403.3.2. In each of these the specific references are replaced by a generic reference to the tables in Section C403.3.2. It is our intent that any other sections which have a specific reference, that it will also be replaced by the generic reference.

Please note that replacement of the IECC tables will result in the following standards no longer being directly referenced in the IECC: AHRI 210/240, AHRI 340/360, AHRI 365, AHRI 390, AHRI 400, AHRI 460, AHRI 560, ANSI/AHAM RAC-1, ANSI Z21.47, ANSI Z83.8, ASHRAE 127, CTI ATC-105, CTI ATC 105S, CTI STD-201 RS, CTI ATC-106, CTI STD 201, ISO 13256-1, ISO 13256-2, UL727, UL731 and NAECA.

Bibliography: ANSI/ASHRAE/IES Standard 90.1

Cost Impact: The code change proposal will not increase or decrease the cost of construction. Some efficiencies in 90.1 for various types of equipment have been changed, and there are some new efficiencies for products that were previously uncovered. In some of those instances, the cost of construction may increase.

Proposal # 4858

CE113-19

CE114-19

IECC: C403.3.3, C403.3.4

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:

C403.3.3 Hot gas bypass limitation (Mandatory). Cooling systems shall not use hot gas bypass or other evaporator pressure control systems unless the system is designed with multiple steps of unloading or continuous capacity modulation. The capacity of the hot gas bypass shall be limited as indicated in Table C403.3.3, as limited by Section C403.5.1.

C403.3.4 Boiler turndown (Mandatory). Boiler systems with design input of greater than 1,000,000 Btu/h (293 kW) shall comply with the turndown ratio specified in Table C403.3.4.

The system turndown requirement shall be met through the use of multiple single-input boilers, one or more modulating boilers or a combination of single-input and modulating boilers.

Reason:

While hot gas bypass limitations and boiler turn down are not technically impossible to model, it is generally considered infeasible to do so. Even if it were to be modeled verifying the assumptions used for the model would be virtually impossible. It is only theoretically tradable, and is not typically – if ever - traded by users of the performance path.

As essentially non-tradeable, C403.3.3 and C403.3.4 should be labeled as mandatory.

Note that 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>

(<http://www.iccsafe.org/cs/SEHPCAC/Pages/default.aspx>)

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

As commonly interpreted, these items are already considered mandatory and would have no impact on cost. However, it may increase the cost of construction for a subset of buildings designed to comply with Section C407 that do not include the specified hot gas bypass limitations or boiler turndown provisions included in Section C403.3.3 and C403.3.4.

CE115-19 Part I

PART I — IECC: Part I: C403.4.1.1 (New)

IECC: Part II: R403.1.2(N1103.1.2) (New)

PART II — IECC: R403.1.2 (IRC N1103.1.2)

Proponent: Steven Rosenstock, Edison Electric Institute, representing Edison Electric Institute
(srosenstock@eei.org)

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

2018 International Energy Conservation Code

Add new text as follows:

C403.4.1.1 Heat pump supplemental heat (Mandatory). Heat pumps having supplemental electric resistance heat shall have controls that prevent supplemental heat operation where the heat pump vapor compression cycle can provide the necessary heating to satisfy the thermostat control.

Exceptions:

1. Defrost operation.
2. Vapor compression cycle malfunction.
3. Thermostat malfunction.

Proposal # 4115

CE115-19 Part I

CE115-19 Part II

IECC: R403.1.2 (IRC N1103.1.2)

Proponent: Steven Rosenstock, Edison Electric Institute, representing Edison Electric Institute
(srosenstock@eei.org)

2018 International Energy Conservation Code

Revise as follows:

R403.1.2 (IRC N1103.1.2) Heat pump supplementary supplemental heat (Mandatory). Heat pumps having supplementary supplemental electric-resistance heat shall have controls that, except during defrost, prevent supplemental heat operation when the heat pump compressor can meet the heating load. Vapor compression cycle can provide the necessary heating to satisfy the thermostat control.

Exceptions:

1. Defrost operation.
2. Vapor compression cycle heating malfunction.
3. Thermostat malfunction.

Reason: This proposal updates this requirement to account for real world operation of heat pumps. There are times when supplemental heat will be needed to be used apart from defrost operation. The reasons for the additional exceptions are as follows:

Vapor compression cycle heating malfunction. If the compressor or reversing valve or metering device (such as a capillary tube or thermal expansion valve) is not working properly, the current requirements do not allow supplemental heat to be used. As a result, the space will not be conditioned, and in extreme cases where the compressor is not fixed, the temperatures could fall to levels where unsafe situations (such as pipes freezing) could develop.

Thermostat malfunction. If the thermostat is not working properly, the current requirements do not allow supplemental heat to be used. As a result, the space may not be conditioned, and when the thermostat is repaired, supplemental heat may be needed in conjunction with the compressor and fan motor to get the space back to its programmed temperature in a short period of time.

It should also be noted that the national energy efficiency standards for residential heat pumps have increased significantly over the past 25 years, and will increase again in January, 2023. Also, with more heat pumps having "smart" technology, the system owner can be notified immediately on a smart phone or computer if such a malfunction is occurring, which will limit such operation.

Cost Impact: The code change proposal will not increase or decrease the cost of construction. This will not increase (or decrease) the cost of construction, as the exceptions shown are already aspects of current heat pump control strategies and will not increase the cost to purchase, install, or operate a heat pump.

Proposal # 4104

CE115-19 Part II

CE116-19 Part I

PART I — IECC: C403.4.1.1

PART II — IECC: R403.1.2 (IRC N1103.1.2)

Proponent: Charles Foster, representing self (cfoster20187@yahoo.com)

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

2018 International Energy Conservation Code

Revise as follows:

C403.4.1.1 Heat pump supplementary heat (Mandatory). Heat pumps having supplementary electric resistance heat shall have controls that ~~-, except during defrost, prevent supplementary heat operation where the heat pump can provide the heating load-~~ limit supplemental heat operation to only those times when:

1. The vapor compression cycle cannot provide the necessary heating energy to satisfy the thermostat setting.
2. The heat pump is operating in defrost mode.
3. The vapor compression cycle malfunctions, or
4. The thermostat malfunctions.

Proposal # 4971

CE116-19 Part I

CE116-19 Part II

IECC: R403.1.2 (IRC N1103.1.2)

Proponent: Charles Foster, representing self (cfoster20187@yahoo.com)

2018 International Energy Conservation Code

Revise as follows:

R403.1.2 (IRC N1103.1.2) Heat pump supplementary heat (Mandatory). Heat pumps having supplementary electric-resistance heat shall have controls that ~~except during defrost, prevent~~ limit supplemental heat operation to only those times when:

1. The vapor compression cycle cannot provide the necessary heating energy to satisfy the heat pump compressor can meet the heating load. thermostat setting.
2. The heat pump is operating in defrost mode.
3. The vapor compression cycle malfunctions, or
4. The thermostat malfunctions.

Reason: This proposal updates this requirement to account for real world operation of heat pumps. There are times when supplemental heat will be needed to be used apart from defrost operation. The reasons for the additional exceptions are as follows:

Vapor Compression cycle malfunction. If the compressor or reversing valve or metering device (such as a capillary tube or thermal expansion valve) is not working properly, the current requirements do not allow supplemental heat to be used. As a result, the space will not be conditioned, and in extreme cases where the compressor is not fixed, the temperatures could fall to levels where unsafe situations (such as pipes freezing) could develop.

Thermostat malfunction. If the thermostat is not working properly, the current requirements do not allow supplemental heat to be used. As a result, the space may not be conditioned, and when the thermostat is repaired, supplemental heat may be needed in conjunction with the compressor and fan motor to get the space back to its programmed temperature in a short period of time.

It should also be noted that the national energy efficiency standards for residential heat pumps have increased significantly over the past 25 years, and will increase again in January, 2023. Also, with more heat pumps having "smart" technology, the system owner can be notified immediately on a smart phone or computer if such a malfunction is occurring, which will limit such operation.

Cost Impact: The code change proposal will not increase or decrease the cost of construction. This will not increase (or decrease) the cost of construction, as the exceptions shown are already aspects of current heat pump control strategies and will not increase the cost to purchase, install, or operate a heat pump.

Proposal # 4979

CE116-19 Part II

CE117-19

IECC: C403.4.1.4

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:

C403.4.1.4 Heated or cooled vestibules (Mandatory). The heating ~~system~~ for heated vestibules and air curtains with integral heating shall be provided with controls ~~configured~~ to shut off the source of heating when the outdoor air temperature is greater than 45°F (7°C) 60°F (16°C). Vestibule heating and cooling systems shall be controlled by a thermostat located in the vestibule configured to limit heating to a temperature not greater than 60°F (16°C) 68°F (20°C) and cooling to a temperature not less than 85°F (29°C).

Exception: Control of heating or cooling provided by site-recovered energy or transfer air that would otherwise be exhausted.

Reason: Why is the proposed code change needed?

Heated vestibules are important in Cold weather climates to provide the thermal separation between the indoors and outdoors. Shutting off the heat source at 45°F will mean that the vestibule temperature will drop to 45°F, which will cause problems with cold air entering the building when the vestibule doors are opened. These problems include causing cold conditions at reception areas of commercial office buildings.

Increasing the allowable controlled temperature within the vestibule provides a better thermal buffer when the doors are opened. With cold outdoor air conditions, the vestibules cool off very quickly when the doors are opened, especially if there is a wind blowing into the vestibule. Problems associated with vestibule in the winter are too low of temperatures and the proposed limitations will only make the problems greater.

Cost Impact: The code change proposal will not increase or decrease the cost of construction. The code already requires the controls to operate the heating and cooling systems for vestibules so there are no additional materials or installation labor necessary. This is simply a change in thermostat set points to maintain reception areas and entrance areas to office buildings at a warmer temperature for those individuals working at or near building entrances. There will be a energy savings in colder climates because keeping this area at a warmer more comfortable temperature, negates the need for the individuals to place a small electric inefficient heater under the desk to stay warm. Less use of portable space heaters in a building will also reduce fire hazards.

Proposal # 5123

CE117-19

CE118-19

IECC: C403.4.1.4

Proponent: Ellen Eggerton, City of Alexandria, representing self (ellen.eggerton@alexandriava.gov)

2018 International Energy Conservation Code

Revise as follows:

C403.4.1.4 Heated or cooled vestibules (Mandatory). The heating system for heated vestibules and air curtains with integral heating shall be provided with controls configured to shut off the source of heating when the outdoor air temperature is greater than ~~45°F~~ 40°F (7°C). Vestibule heating ~~and cooling systems~~ shall be controlled by a thermostat located in the vestibule configured to limit heating to a temperature not greater than ~~60°F~~ 50°F (16°C 10°C) ~~and cooling to a temperature not less than 85°F (29°C)~~. Mechanical cooling of vestibules is prohibited.

Exception: Control of heating or cooling provided by site-recovered energy or transfer air that would otherwise be exhausted.

Reason: Vestibules are a transition from conditioned to unconditioned space. Vestibules only require freeze protection for sprinklers and maintaining door operations during cold weather. Cooling vestibules wastes cooling energy each time the outside outside doors open.

Better designed vestibules minimize the movement of air into the building by a design where the outside door starts to close as the inside door is opening other than during high traffic times or has a change in direction to reduce the flow of air infiltration of unconditioned air.

Cost Impact: The code change proposal will not increase or decrease the cost of construction. This change will not increase construction cost as thermostatic controls are already required. This change will reduce operating energy consumption.

Proposal # 5422

CE118-19

CE119-19

IECC: C403.4.2.1

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:

C403.4.2.1 Thermostatic setback (Mandatory). Thermostatic setback controls shall be configured to set back or temporarily operate the system to maintain zone temperatures down to 55°F (13°C) or up to 85°F (29°C). Heating systems shall be configured with controls to automatically restart and temporarily operate the systems to maintain setback zone temperatures above the heating setpoint adjustable down to 55°F (13°C). Cooling systems shall be configured with controls to automatically restart and temporarily operate the system to maintain setback zone temperatures below a cooling setpoint adjustable up to 85°F (29°C) or to prevent excessive space humidity levels.

Exceptions:

1. Radiant floor and radiant ceiling heating systems.
2. Spaces where constant temperature conditions must be maintained.

Reason: Why is the proposed code change needed?

It clarifies the heating conditions and cooling conditions. It is important to control the humidity level in the summer. Radiant heating systems should not be reset because their thermal mass causes them to change conditions very slowly, which can be problematic towards maintaining comfort conditions in the occupied spaces

Cost Impact: The code change proposal will not increase or decrease the cost of construction. The code already requires the set back thermostat controls, so there are no additional materials or installation labor necessary. This code change simply clarifies heating and cooling conditions and control humidity levels in buildings. Latent Loads on a building will cause the systems to operate poorly resulting in more energy to reduce moist loads that make the building more comfortable for its occupants.

Proposal # 5067

CE119-19

CE120-19

IECC: C403.4.2.3

Proponent: Nicholas O'Neil, NW Energy Codes Group, representing NW Energy Codes Group
(noneil@energy350.com)

2018 International Energy Conservation Code

Revise as follows:

C403.4.2.3 Automatic start and stop (Mandatory). Automatic start and stop controls shall be provided for each HVAC system. The automatic start controls shall be configured to automatically adjust the daily start time of the HVAC system in order to bring each space to the desired occupied temperature immediately prior to scheduled occupancy. The automatic stop controls shall be configured to reduce the HVAC system's heating temperature setpoint and increase the cooling temperature setpoint by at least 2°F before scheduled unoccupied periods based upon the thermal lag and acceptable drift in space temperature that is within comfort limits.

Reason: The IECC currently requires Automatic Start but neglects to include Automatic Stop controls which can further reduce energy use with minimal cost. This feature has been commonplace on DDC and BMS control systems for many years and is now becoming commonplace with standalone building thermostats as well, making this feature a market-ready solution to further reduce energy costs. The primary economic impact is a reduction in energy consumption through the use of existing building controls. There is a direct benefit to the building owner, tenants, and businesses via a reduction in energy costs related to reduced cooling and heating loads.

Cost Impact: The code change proposal will not increase or decrease the cost of construction. Systems that include Automatic Start are capable of implementing Automatic Stop as well. The financial impact on construction is effectively zero as the additional labor to program the Automatic Stop control algorithm into a BMS or DDC system that is already required to have Automatic Start is minimal.

Proposal # 4929

CE120-19

CE121-19

IECC: C403.4.3.3.2

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

2018 International Energy Conservation Code

C403.1.1 Calculation of heating and cooling loads. Design loads associated with heating, ventilating and air conditioning of the building shall be determined in accordance with ANSI/ASHRAE/ACCA Standard 183 or by an *approved* equivalent computational procedure using the design parameters specified in Chapter 3. Heating and cooling loads shall be adjusted to account for load reductions that are achieved where energy recovery systems are utilized in the HVAC system in accordance with the ASHRAE *HVAC Systems and Equipment Handbook* by an approved equivalent computational procedure.

Revise as follows:

C403.4.3.3.2 Heat rejection. The following shall apply to hydronic water loop heat pump systems in Climate Zones 3 through 8:

1. Where a closed-circuit cooling tower is used directly in the heat pump loop, either an automatic valve shall be installed to bypass the flow of water around the closed-circuit cooling tower, except for any flow necessary for freeze protection, or low-leakage positive-closure dampers shall be provided.
2. Where an open-circuit cooling tower is used directly in the heat pump loop, an automatic valve shall be installed to bypass all heat pump water flow around the open-circuit cooling tower.
3. Where an open-circuit or closed-circuit cooling tower is used in conjunction with a separate heat exchanger to isolate the open-circuit cooling tower from the heat pump loop, heat loss shall be controlled by shutting down the circulation pump on the cooling tower loop.

Exception: Where it can be demonstrated that a heat pump system will be required to reject heat throughout the year.

Reason: There may be installations where a closed-circuit cooling tower is used for the described purposes. The circulation pumps for the closed-circuit cooling tower should be treated the same as for the open-circuit cooling tower

Cost Impact: The code change proposal will not increase or decrease the cost of construction. This proposal may increase costs when closed circuit towers are used in conjunction with a separate heat exchanger, which is happening currently every day. We believe the intent of the original language was to include requirements for both open and closed-circuit towers but adding closed circuit was mistakenly left out of the code language. It makes sense to have the language for both open and closed in this specific case or use.

Proposal # 5122

CE121-19

CE122-19

IECC: C403.4.3.3.3

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:

C403.4.3.3.3 Two-position valve. Each hydronic heat pump on the hydronic system having a total pump system power exceeding 10 hp (7.5 kW) shall have a two-position automatic valve interlocked to shut off the water flow when the compressor is off

Reason: 1. **Reason** Why is the proposed code change needed?

The two position valve needs to be an automatic valve to shut off when the heat pump compressor is off. It is also important to interlock with the compressor so that the compressor does not run unless the valve is open. This wording makes this section essentially the same as Section C403.4.3.3.3.

2. Why is the proposed code change a reasonable solution?

Because it is the correct method to install automatic valves in heat pump systems.

If the interlock is not installed correctly, there will be problems with heat pumps tripping out.

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

The two position valve is already required by the code. Typically, these valves are automatic so in most cases, no additional materials or installation labor are necessary. This proposal simply clarifies that they should be automatic to provide for the intended operation. These valves save on operational costs of the system by not running heat pumps when the pumps not needed. Proper interlocking reduces excess wear and tear on the pumps which adds longevity to the system.

Proposal # 5066

CE122-19

CE123-19

IECC: C403.5

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); Gina Bocra, representing New York City Department of Buildings (gbocra@buildings.nyc.gov)

2018 International Energy Conservation Code

Revise as follows:

C403.5 Economizers (Prescriptive). Economizers shall comply with Sections C403.5.1 through C403.5.5.

An air or water economizer shall be provided for the following cooling systems:

1. Chilled water systems with a total cooling capacity, less cooling capacity provided with air economizers, as specified in Table C403.5(1).
2. Individual fan systems with cooling capacity greater than or equal to 54,000 Btu/h (15.8 kW) ~~in buildings having~~ serving other than a Group R occupancy occupancies.
The total supply capacity of all fan cooling units not provided with economizers shall not exceed 20 percent of the total supply capacity of all fan cooling units in the building or 300,000 Btu/h (88 kW), whichever is greater.
3. Individual fan systems with cooling capacity greater than or equal to 270,000 Btu/h (79.1 kW) ~~in buildings having a serving Group R occupancy occupancies.~~ The total supply capacity of all fan cooling units not provided with economizers shall not exceed 20 percent of the total supply capacity of all fan cooling units in the building or 1,500,000 Btu/h (440 kW), whichever is greater.

Exceptions: Economizers are not required for the following systems.

1. Individual fan systems not served by chilled water for buildings located in *Climate Zones* 1A and 1B.
2. Where more than 25 percent of the air designed to be supplied by the system is to spaces that are designed to be humidified above 35°F (1.7°C) dew-point temperature to satisfy process needs.
3. Systems expected to operate less than 20 hours per week.
4. Systems serving supermarket areas with open refrigerated casework.
5. Where the cooling efficiency is greater than or equal to the efficiency requirements in Table C403.5(2).
6. Systems that include a heat recovery system in accordance with Section C403.9.5.

Reason: This change more correctly represents the intent of the code, which is specifically, the occupancy served by economizers.

Bibliography: 2018 IECC

Cost Impact: The code change proposal will not increase or decrease the cost of construction. This is a clarification only and will not effect the requirements of the energy code.

Proposal # 4872

CE123-19

CE124-19

IECC: C403.5

Proponent: Julius Ballanco, JB Engineering and Code Consulting, P.C., representing Daikin US (JBEngineer@aol.com)

2018 International Energy Conservation Code

Revise as follows:

C403.5 Economizers (Prescriptive). Economizers shall comply with Sections C403.5.1 through C403.5.5. An air or water economizer shall be provided for the following cooling systems:

1. Chilled water systems with a total cooling capacity, less cooling capacity provided with air economizers, as specified in Table C403.5(1).
2. Individual fan systems with cooling capacity greater than or equal to 54,000 Btu/h (15.8 kW) in buildings having other than a *Group R* occupancy. The total supply capacity of all fan cooling units not provided with economizers shall not exceed 20 percent of the total supply capacity of all fan cooling units in the building or 300,000 Btu/h (88 kW), whichever is greater.
3. Individual fan systems with cooling capacity greater than or equal to 270,000 Btu/h (79.1 kW) in buildings having a *Group R* occupancy. The total supply capacity of all fan cooling units not provided with economizers shall not exceed 20 percent of the total supply capacity of all fan cooling units in the building or 1,500,000 Btu/h (440 kW), whichever is greater.

Exceptions: Economizers are not required for the following systems.

1. Individual fan systems not served by chilled water for buildings located in *Climate Zones* 1A and 1B.
2. Where more than 25 percent of the air designed to be supplied by the system is to spaces that are designed to be humidified above 35°F (1.7°C) dew-point temperature to satisfy process needs.
3. Systems expected to operate less than 20 hours per week.
4. Systems serving supermarket areas with open refrigerated casework.
5. Where the cooling efficiency is greater than or equal to the efficiency requirements in Table C403.5(2).
6. Systems that include a heat recovery system in accordance with Section C403.9.5.
7. VRF systems installed with a dedicated outdoor air system.

Reason: VRF (variable refrigerant flow) systems are unique in that they rely on the heating and cooling of the air within a room of space. There is no massive installation of ducts to move air through a central air handling system. Outside air is provided by a dedicated outside air (DOA) system. This type of heating and cooling system does not lend itself to having an economizer. The DOA system would have to be completely oversized in order to accomplish cooling with outside air. That defeats the purpose of this highly efficient heating and cooling system.

An analysis was done comparing a VRF system with a DOA system to a typical roof top air handling unit having an economizer cycle. The two areas of the country analyzed were Chicago and Houston. The cooling energy use was compared since economizers provide cooling with outside air. The VRF with DOA used 45.5% less energy to cool a building in Chicago. For the same building in Houston, the VRF with DOA used 32.9% less energy than a rooftop unit.

This proves that a VRF system with a DOA system is more efficient than a standard rooftop unit with an

economizer cycle. The code should be modified to recognize this energy savings.

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

An economizer for a VRF system is very expensive since there would have to be oversizing of DOA ducts and a larger air handler for the DOA system.

Proposal # 5102

CE124-19

CE125-19

IECC: C403.6.5, C405.6.5.1(New)

Proponent: Connor Barbaree, representing ASHRAE (cbarbaree@ashrae.org)

2018 International Energy Conservation Code

Revise as follows:

C403.6.5 Supply-air temperature reset controls. Multiple-zone HVAC systems shall include controls that are capable of and configured to automatically reset the supply-air temperature in response to representative building loads, or to outdoor air temperature. The controls shall be configured to reset the supply air temperature not less than 25 percent of the difference between the design supply-air temperature and the design room air temperature. Controls that adjust the reset based on zone humidity are allowed in Climate Zones 0B, 1B, 2B, 3B, 3C and 4 through 8. HVAC zones that are expected to experience relatively constant loads, shall have maximum airflow designed to accommodate the fully reset supply air temperature.

Exceptions:

1. Systems that prevent reheating, recooling or mixing of heated and cooled supply air.
2. Seventy-five percent of the energy for reheating is from site-recovered or site-solar energy sources.
3. Systems in Climate Zones with peak supply air quantities of 300 cfm (142 L/s) or less: 0A, 1A, and 3A with less than 3000 cfm (1500 L/s) of design outside air.
4. Systems in Climate Zone 2A with less than 10,000 cfm (5000 L/s) of design outside air.
5. Systems in Climate Zones 0A, 1A, 2A, and 3A with not less than 80 percent outside air and employing exhaust air energy recovery complying with Section C403.7.4.

Add new text as follows:

C403.6.5.1 Dehumidification Control Interaction. In Climate Zones 0A, 1A, 2A, and 3A, the system design shall allow supply air temperature *reset* while dehumidification is provided. When dehumidification *control* is active, air economizers shall be locked out.

Reason: HVAC systems with simultaneous heating and cooling require supply air temperature (SAT) reset. However, in climate zones 0A through 3A the SAT reset is likely to be overridden during dehumidification conditions. In these climate zones, several system types can successfully dehumidify the outside air while still providing SAT reset and reducing reheat energy use. By providing specific requirements related to dehumidification control interaction, the requirement for concurrent SAT reset is clarified.

Supply temperature reset saves significant heating energy in VAV reheat systems in high outside air systems, and that savings is higher in climate zone 3A than 2A, 1A and 0A. Separately dehumidifying the outside air reduces the total volume of air that must be cooled, significantly reducing cooling energy use in all the warm and humid climate zones.

An investigation using EnergyPlus of a system with a separate outside air coil for dehumidification for buildings with both 50% and 10% outside air using dual-max controlled VAV reheat boxes was conducted. It found that this approach was cost effective at or above 3000 cfm of outside air in climate zones 0A, 1A, and 3A. In climate zone 2A, cost effectiveness was found for systems with 10,000 cfm or more of outside air. In all but climate zone 2A both the low and high outside air cases were cost effective at or above 3000 cfm of outside air. In climate zone 2A, the low cfm case had a longer payback and did not meet the cost effective threshold at 3000 cfm, so the airflow threshold was increased for climate zone 2A to 10,000 cfm. The exception for zones with

less than 300 cfm (142 L/s) was removed, as costs relate to the main system outside airflow, not the zone airflow.

While the system with a separate outside air cooling coil proved cost effective, there are other allowed systems that may have lower costs that produce similar savings. These include: bypassing return air around the cooling coil, a dedicated outside air system, and series heat recovery. The revisions proposed improve coordination with ASHRAE Standard 90.1.

Bibliography: Addendum *ap* to ASHRAE standard 90.1-2016.

Cost Impact: The code change proposal will increase the cost of construction. The code change proposal may increase the cost of construction where a bypass or separate outside air cooling coil is added. An analysis found that the proposed changes in addendum *ap* to ASHRAE standard 90.1-2016—clearly requiring SAT reset in more climate zones—would be cost effective in line with the exceptions provided.

Proposal # 4916

CE125-19

CE126-19

IECC: C403.6.9

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:

C403.6.9 Static pressure sensor location. Static pressure sensors used to control VAV fans shall be located such that the controller setpoint is not greater than 1.2 inches w.c. (299 Pa)–, except for systems with zone reset control complying with Section C403.6.8, Setpoints for direct digital control. Sensors shall be located in a position so the controller setpoint is optimized to maintain the minimum static pressure required for system operation throughout its range. Where this results in one or more sensors being located downstream of major duct splits, not less than one sensor shall be located on each major branch to ensure that static pressure can be maintained in each branch.

Reason: Determining where the system pressure does not exceed 1.2 inches could be difficult. When Section C403.6.9 is used, the setpoint is continually optimized, meaning that determining where the 1.2 inches is not exceeded becomes unnecessary,

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

Where the system designer chooses a direct digital control system for control of VAVs, sensors are already an integral part of the system. Therefore , no additional materials or installation labor are necessary . The proposal simply clarifies the location for those sensors. The continual optimization of static pressure on the system reduces the energy usage of the building.

Proposal # 5115

CE126-19

CE127-19

IECC: C403.7.1

Proponent: Nicholas O'Neil, NW Energy Codes Group, representing NW Energy Codes Group
(noneil@energy350.com)

2018 International Energy Conservation Code

Revise as follows:

C403.7.1 Demand control ventilation (Mandatory). Demand control ventilation (DCV) shall be provided for all single-zone systems required to comply with Sections C403.5 through 403.5.3 and spaces larger than 500 square feet (46.5 m²) and with an average occupant load of 25 people or greater per 1,000 square feet (93 m²) of floor area, as established in Table 403.3.1.1 of the International Mechanical Code, and served by systems with one or more of the following:

1. An air-side economizer.
2. Automatic modulating control of the outdoor air damper.
3. A design outdoor airflow greater than 3,000 cfm (1416 L/s).

Exceptions:

1. Systems with energy recovery complying with Section C403.7.4.
2. Multiple-zone systems without direct digital control of individual zones communicating with a central control panel.
3. ~~Systems~~ Multiple-zone systems with a design outdoor airflow less than 1,200 cfm (566 L/s).
4. Spaces where the supply airflow rate minus any makeup or outgoing transfer air requirement is less than 1,200 cfm (566 L/s).
5. Ventilation provided only for process loads.

Reason: Many spaces are over-ventilated due to design professionals establishing ventilation rates based on peak design conditions that rarely exist on a daily basis. Substantial energy savings can be obtained even in low-occupancy areas through the implementation of DCV. CO2 sensor costs have fallen in recent years making DCV on smaller sized units that already require economizers, (and therefore already have modulating dampers) more cost-effective than they have been in the past.

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

A single CO₂ sensor in the return air duct of a single zone system is expected to cost less than \$300 and provides assurance that indoor air quality in smaller spaces will be maintained to safe CO₂ levels. Note that the requirement for installing DCV is only on units that are already required to have an economizer installed, which drastically reduces the cost of implementing DCV.

Proposal # 4935

CE127-19

CE128-19

IECC: C403.7.1

Proponent: Connor Barbaree, representing ASHRAE (cbarbaree@ashrae.org)

2018 International Energy Conservation Code

Revise as follows:

C403.7.1 Demand control ventilation (Mandatory). Demand control ventilation (DCV) shall be provided for spaces larger than 500 square feet (46.5 m²) and with an average occupant load of 25 people or greater per 1,000 square feet (93 m²) of floor area, as established in Table 403.3.1.1 of the International Mechanical Code, and served by systems with one or more of the following:

1. An air-side economizer.
2. Automatic modulating control of the outdoor air damper.
3. A design outdoor airflow greater than 3,000 cfm (1416 L/s).

Exceptions:

1. Systems with energy recovery complying with Section C403.7.4.
2. Multiple-zone systems without direct digital control of individual zones communicating with a central control panel.
3. Systems with a design outdoor airflow less than 1,200 cfm (566 L/s).
4. Spaces where more than 75 percent of the supply airflow rate minus any makeup or outgoing transfer air requirement is less than 1,200 cfm (566 L/s): space design outdoor airflow is required for makeup air that is exhausted from the space or transfer air that is required for makeup air that is exhausted from other spaces.
5. Spaces with one of the following occupancy classifications as defined in Table 403.3.1.1 of the International Mechanical Code : correctional cells, education laboratories, barber, beauty and nail salons, and bowling alley seating areas.
5. ~~Ventilation provided only for process loads.~~

Reason: The revisions to the DCV exceptions improve coordination with ASHRAE Standard 90.1-2013 and later. Based on improved availability of DCV controls at lower costs, the outdoor airflow exception was reduced from 1,200 cfm (566 L/s) to 750 cfm (375 L/s). The transfer air exception was changed from a fixed outside airflow amount to a percentage of outdoor air, to allow exceptions where the DCV control implementation would be difficult due to the large percentage of transfer or makeup air. The exception for ventilation for process loads would be covered by the percentage makeup air exception, so it was removed as redundant. In conjunction with the reduction of excepted spaces, certain spaces were identified where DCV would simply not work—bowling alley seating areas—or would not be appropriate to maintain adequate indoor air quality.

Bibliography: Addendum as to ASHRAE standard 90.1-2010. Available at:
<https://www.ashrae.org/File%20Library/Technical%20Resources/Standards%20and%20Guidelines/Standards%20/>

Cost Impact: The code change proposal will increase the cost of construction. The code change proposal will increase the cost of construction in cases where systems would have been exempt under the old exceptions; however, this is in the context of reduced cost of DCV controls as a result of more widespread use. In certain cases with a high percentage of makeup air or transfer air, the cost of construction will be reduced. An analysis found that the proposed changes in addendum as to ASHRAE standard 90.1-2010—requiring DCV in more spaces—would be cost effective in all climate zones.

CE129-19

IECC: C403.7.2

Proponent: Nicholas O'Neil, Energy 350, representing Energy 350 (noneil@energy350.com)

2018 International Energy Conservation Code

Revise as follows:

C403.7.2 Enclosed parking garage ventilation controls (Mandatory). Enclosed parking garages used for storing or handling automobiles operating under their own power shall employ ~~contamination-sensing devices~~ carbon monoxide detectors applied in conjunction with nitrogen dioxide detectors and automatic controls configured to stage fans or modulate fan average airflow rates to 50 percent or less of design capacity, or intermittently operate fans less than 20 percent of the occupied time or as required to maintain acceptable contaminant levels in accordance with International Mechanical Code provisions. Failure of contamination-sensing devices shall cause the exhaust fans to operate continuously at design airflow.

Exceptions:

1. Garages with a total exhaust capacity less than ~~22 8,500 000~~ cfm (~~10 620 3 775~~ L/s) with ventilation systems that do not utilize heating or mechanical cooling and use occupant sensors to activate the full required ventilation rate.
2. Garages that have a garage area to ventilation system motor nameplate power ratio that exceeds 1125 cfm/hp (710 L/s/kW) and do not utilize heating or mechanical cooling.

Reason: The current threshold for exempting parking ventilation controls ignores a substantial percentage of the parking garage market that could benefit from reduced fan ventilation during times of low (or no) occupancy. The cost of fan system controls and sensors has fallen in recent years making ventilation controls on smaller sized garages more cost-effective than they have been in the past.

Cost Impact: The code change proposal will increase the cost of construction. The primary components required are sensors, controllers and fan variable frequency drives (VFDs). The cost for implementing this code requirement is estimated at \$400 per 1,000 square feet of parking garage, or \$0.40 per square foot. Additionally, the payback for this code proposal is less than 5 years and will be faster for larger garage sizes.

Proposal # 4932

CE129-19

CE130-19

IECC: C403.7.2.1(New), C403.7.2.2(New), C403.7.2.3(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

SECTION C403 BUILDING MECHANICAL SYSTEMS

C403.7.2 Enclosed parking garage ventilation controls (Mandatory). Enclosed parking garages used for storing or handling automobiles operating under their own power shall employ contamination-sensing devices and automatic controls configured to stage fans or modulate fan average airflow rates to 50 percent or less of design capacity, or intermittently operate fans less than 20 percent of the occupied time or as required to maintain acceptable contaminant levels in accordance with International Mechanical Code provisions. Failure of contamination-sensing devices shall cause the exhaust fans to operate continuously at design airflow.

Exceptions:

1. Garages with a total exhaust capacity less than 22,500 cfm (10 620 L/s) with ventilation systems that do not utilize heating or mechanical cooling.
2. Garages that have a garage area to ventilation system motor nameplate power ratio that exceeds 1125 cfm/hp (710 L/s/kW) and do not utilize heating or mechanical cooling.

Add new text as follows:

403.7.2.1 Enclosed parking garages. Mechanical ventilation systems for enclosed parking garages shall automatically operate upon detection of certain gases. Parking garages must be equipped with carbon monoxide (CO) detection sensors that will activate the mechanical ventilation system upon detection of a CO level of 25 part per million (ppm) or greater. Parking garages must also be equipped with nitrogen dioxide (NO₂) detection sensors that will activate the mechanical ventilation system upon detection of a NO₂ level of 3 ppm or greater. Such detectors shall be listed in accordance with UL 2075 and installed in accordance with their listing and the manufacturers' instructions.

403.7.2.2 Minimum exhaust.

The mechanical ventilation system shall provide a minimum exhaust rate of 0.75 cfm per square foot [0.0038 m³/s-m²] of the floor area served.

403.7.2.3 Occupied spaces accessory to public garages. Connecting offices, elevator lobbies, waiting rooms, ticket booths and similar uses that are accessory to a public garage shall be maintained at a positive pressure and shall be provided with ventilation in accordance with Section 403.3.1.

Reason: Why is the proposed code change needed?

Experience has shown that it is unnecessary to continuously ventilate parking garages to maintain safe air quality conditions within, especially during periods of minimal or no vehicular activity, such as nights or weekends. Requiring continuous ventilation will create temperature conditions in the garage that are the same as the outdoors, which is not always desirable, especially during very cold outdoor conditions. Requiring CO and NO₂ sensors and control maintains safe conditions within the enclosed parking garages even with vehicular activity.

The proposed revisions are essentially the same as the current Minnesota requirements, which have been in

place for a long time and have worked well. Some language is clarified, and the UL standards for the CO and NO₂ sensors was added. It is important to identify the concentrations of these gases where the ventilation system is activated because the sensors have different settings.

Our existing code identifies the CO sensor requirements for parking garages containing gas fueled vehicles and NO₂ sensor requirements for garages containing diesel fueled vehicles. This proposed change requires both types of sensors to be required in all enclosed parking garages because there is no reasonable method of separating out garage service, and diesel vehicles are more common.

Why is the proposed code change a reasonable solution?

It brings forward and updates the existing requirements for enclosed parking garages.

Cost Impact: The code change proposal will not increase or decrease the cost of construction. The code already requires the detection sensors therefore, no additional materials or installation labor are necessary. The proposal simply clarifies the necessary details about the sensor contaminate types and activation thresholds.

Proposal # 5117

CE130-19

CE131-19

IECC: C403.7.4

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

2018 International Energy Conservation Code

Revise as follows:

C403.7.4 Energy recovery ventilation systems (Mandatory). Where the supply airflow rate of a fan system exceeds the values specified in Tables C403.7.4(1) and C403.7.4(2), the system shall include an energy recovery system. The energy recovery system shall be configured to provide a change in the enthalpy of the outdoor air supply of not less than 50 percent of the difference between the outdoor air and return air enthalpies, at design conditions. Where an air economizer is required, the energy recovery system shall include a bypass or controls that permit operation of the economizer as required by Section C403.5.

Exception: An energy recovery ventilation system shall not be required in any of the following conditions:

1. Where energy recovery systems are prohibited by the International Mechanical Code .
2. Laboratory fume hood systems that include not fewer than one of the following features:
 - 2.1. Variable-air-volume hood exhaust and room supply systems configured to reduce exhaust and makeup air volume to 50 percent or less of design values.
 - 2.2. Direct makeup (auxiliary) air supply equal to or greater than 75 percent of the exhaust rate, heated not warmer than 2°F (1.1 °C) above room setpoint, cooled to not cooler than 3°F (1.7°C) below room setpoint, with no humidification added, and no simultaneous heating and cooling used for dehumidification control.
3. Systems serving spaces that are heated to less than 60°F (15.5°C) and that are not cooled.
4. Where more than 60 percent of the outdoor heating energy is provided from site-recovered or site-solar energy.
5. Heating energy recovery in *Climate Zones* 1 and 2.
6. Cooling energy recovery in *Climate Zones* 3C, 4C, 5B, 5C, 6B, 7 and 8.
7. Systems requiring dehumidification that employ energy recovery in series with the cooling coil.
8. Where the largest source of air exhausted at a single location at the building exterior is less than 75 percent of the design *outdoor air* flow rate.
9. Systems expected to operate less than 20 hours per week at the *outdoor air* percentage covered by Table C403.7.4(1).
10. Systems exhausting toxic, flammable, paint or corrosive fumes or dust.
11. Commercial kitchen hoods used for collecting and removing grease vapors and smoke.
12. Individual ventilation systems that serve an individual dwelling unit or sleeping unit.

Reason: This code change proposal increases the ease of use of the Code without changing the de facto requirements of this Mandatory provision. Individual ventilation systems that serve individual dwelling units are already not required to use Energy recovery ventilation systems based on the tables below. The math and logic to arrive at that answer can be difficult and confusing however. This exception then just pre-states when it already a reality is such a way to save the user of the Code time and effort in understanding and implementing to Code.

Cost Impact: The code change proposal will not increase or decrease the cost of construction. This code change proposal simplifies the understanding and implementation of Code without changing the underlying requirement.

CE132-19

IECC: C202 (New), C403.7.4, C403.7.4.1(New), C403.7.4.2(New)

Proponent: Mike Moore, Newport Ventures, representing Broan-NuTone (mmoore@newportventures.net)

2018 International Energy Conservation Code

SECTION C202 GENERAL DEFINITIONS

Add new definition as follows:

ENTHALPY RECOVERY RATIO. Change in the enthalpy of the outdoor air supply divided by the difference between the outdoor air and entering exhaust air enthalpy, expressed as a percentage.

Revise as follows:

C403.7.4 Energy recovery ventilation systems (Mandatory). ~~systems.~~ Where the supply airflow rate of a fan system exceeds the values specified in Tables C403.7.4(1) and C403.7.4(2), the system shall include an energy recovery system. The energy recovery system shall be configured to provide a change in the enthalpy of the outdoor air supply of not less than 50 percent of the difference between the outdoor air and return air enthalpies, at design conditions. Where an air economizer is required, the energy recovery system shall include a bypass or controls that permit operation of the economizer as required by Section C403.5. Energy recovery ventilation systems shall comply with Sections C403.7.4.1 and Section C403.7.4.2.

Exception: An energy recovery ventilation system shall not be required in any of the following conditions:

- 1. Where energy recovery systems are prohibited by the International Mechanical Code ;
- 2. Laboratory fume hood systems that include not fewer than one of the following features:
 - 1. 2.1. Variable air volume hood exhaust and room supply systems configured to reduce exhaust and makeup air volume to 50 percent or less of design values.
 - 2. 2.2. Direct makeup (auxiliary) air supply equal to or greater than 75 percent of the exhaust rate, heated not warmer than 2°F (1.1°C) above room setpoint, cooled to not cooler than 3°F (1.7°C) below room setpoint, with no humidification added, and no simultaneous heating and cooling used for dehumidification control.
- 3. Systems serving spaces that are heated to less than 60°F (15.5°C) and that are not cooled.
- 4. Where more than 60 percent of the outdoor heating energy is provided from site-recovered or site-solar energy.
- 5. Heating energy recovery in *Climate Zones* 1 and 2.
- 6. Cooling energy recovery in *Climate Zones* 3C, 4C, 5B, 5C, 6B, 7 and 8.
- 7. Systems requiring dehumidification that employ energy recovery in series with the cooling coil.
- 8. Where the largest source of air exhausted at a single location at the building exterior is less than 75 percent of the design outdoor air flow rate.
- 9. Systems expected to operate less than 20 hours per week at the outdoor air percentage covered by Table C403.7.4(1).
- 10. Systems exhausting toxic, flammable, paint or corrosive fumes or dust.
- 11. Commercial kitchen hoods used for collecting and removing grease vapors and smoke.

Add new text as follows:

C403.7.4.1 Nontransient dwelling units (Prescriptive). Nontransient dwelling units shall be provided with outdoor air energy recovery ventilation systems with an enthalpy recovery ratio of not less than 50% at cooling design condition and not less than 60% at heating design condition.

Exceptions:

1. Nontransient dwelling units in Climate Zone 3C.

2. Nontransient dwelling units with no more than 500 ft² of conditioned floor area in Climate Zones 0, 1, 2, 3, 4C, and 5C.

3. Enthalpy recovery ratio requirements at heating design condition in Climate Zones 0, 1, and 2.

4. Enthalpy recovery ratio requirements at cooling design condition in Climate Zones 4, 5, 6, 7, and 8.

C403.7.3.2 Spaces other than nontransient dwelling units (Mandatory). Where the supply airflow rate of a fan system serving a space other than a nontransient dwelling unit exceeds the values specified in Tables C403.7.4(1) and C403.7.4(2), the system shall include an energy recovery system. The energy recovery system shall provide an enthalpy recovery ratio of not less than 50 percent at design conditions. Where an air economizer is required, the energy recovery system shall include a bypass or controls that permit operation of the economizer as required by Section C403.5.

Exception: An energy recovery ventilation system shall not be required in any of the following conditions:

1. Where energy recovery systems are prohibited by the International Mechanical Code.
2. Laboratory fume hood systems that include not fewer than one of the following features:
 - 2.1. Variable-air-volume hood exhaust and room supply systems configured to reduce exhaust and makeup air volume to 50 percent or less of design values.
 - 2.2. Direct makeup (auxiliary) air supply equal to or greater than 75 percent of the exhaust rate, heated not warmer than 2°F (1.1°C) above room setpoint, cooled to not cooler than 3°F (1.7°C) below room setpoint, with no humidification added, and no simultaneous heating and cooling used for dehumidification control.
3. Systems serving spaces that are heated to less than 60°F (15.5°C) and that are not cooled.
4. Where more than 60 percent of the outdoor heating energy is provided from site-recovered or site-solar energy.
5. Enthalpy recovery ratio requirements in Climate Zones 1 and 2.
6. Enthalpy recovery ratio requirements in Climate Zones 3C, 4C, 5B, 5C, 6B, 7 and 8.
7. Systems requiring dehumidification that employ energy recovery in series with the cooling coil.
8. Where the largest source of air exhausted at a single location at the building exterior is less than 75 percent of the design outdoor air flow rate.
9. Systems expected to operate less than 20 hours per week at the outdoor air percentage covered by Table C403.7.4(1).
10. Systems exhausting toxic, flammable, paint or corrosive fumes or dust.
11. Commercial kitchen hoods used for collecting and removing grease vapors and smoke.

Reason: This proposal aligns ASHRAE 90.1 and the IECC requirements for energy recovery ventilation systems by:

1) Changing the specification of heat and energy recovery ventilation systems (H/ERVs) for nontransient* dwelling units from Mandatory to Prescriptive, and

2) Adding minimum prescriptive path requirements for nontransient* dwelling unit H/ERVs in the prescriptive path, where cost effective.

*Based on the IBC definition of “transient”, “nontransient” dwelling units are those that are occupied for more than 30 days; this term carries the same meaning as used in Section 310 of the 2018 IBC.

Prior to the publication of addendum ay to ASHRAE 90.1-2017, both 90.1 and IECC Section C403.7.4 contained energy recovery ventilation requirements that were developed without consideration given for dwelling units within the scope of 90.1 and the IECC. In an effort to develop rational energy recovery ventilation requirements for nontransient dwelling units, 90.1 considered building energy simulations that were conducted on a nominal 1000 ft², 2-bedroom apartment in compliance with the prescriptive path of 90.1 across all climate zones. Four ventilation systems were evaluated for outdoor air: exhaust-only, dedicated supply, central fan integrated supply, and balanced with energy recovery. Ventilation rates were set in accordance with the minimum permitted by ASHRAE 62.2 (comparable to 2018 IMC minimum requirements for mechanical ventilation of high-rise dwelling units). Simulations were run in EnergyPlus. A list of detailed inputs and outputs is also provided in a separate Excel file, with a narrative available in a PowerPoint document. The simulations and accompanying economic analysis resulted in a very favorable scalar ratio (ASHRAE 90.1’s metric for cost effectiveness**) for dwelling unit energy recovery ventilation systems in all climate zones except for 3C for typical dwelling units and except for climate zones 0B, 1, 2, 3, 4C, and 5C for small dwelling units (i.e., no more than 500 ft²). Additionally, the proposal exempts all dwelling units in climate zones 0, 1, 2, and 3C from heating energy recovery requirements and climate zones 3C, 4, 5, 6, 7, and 8 from cooling energy recovery requirements based on insignificant energy savings. This proposal to the IECC mirrors what was vetted and developed over several months by ASHRAE Technical Committee TC5.5 prior to submitting to the 90.1 Mechanical Subcommittee and ultimately approved as addendum ay by the full 90.1 committee.

**A “favorable scalar” is 12.5 or less for heat exchangers with an expected life of 15 years. The economic analysis behind 90.1 addendum ay and this proposal showed an average scalar of 2.9 for the 1008 ft² apartment across all climate zones, and an average of 9.3 for the 500 ft² apartment across all climate zones but the exempted climate zones 0, 1, 2, 3, 4C, and 5C.

For an overview of ASHRAE 90.1’s economic model and the scalar method, a presentation summarizing the building energy simulations supporting ASHRAE 90.1 addendum ay and this proposal, and an Excel workbook with the building energy simulation inputs, results, and economic analysis, see this link:
<https://www.dropbox.com/sh/tbjpbqyz2tccqlk/AADJUnPOlwumQVcJJJeVGjsNoa?dl=0>.

Bibliography: For an overview of ASHRAE 90.1’s economic model and the scalar method, a presentation summarizing the building energy simulations supporting ASHRAE 90.1 addendum ay and this proposal, and an Excel workbook with the building energy simulation inputs, results, and economic analysis, see this link:
<https://www.dropbox.com/sh/tbjpbqyz2tccqlk/AADJUnPOlwumQVcJJJeVGjsNoa?dl=0>.

Cost Impact: The code change proposal will increase the cost of construction. By moving the requirement for nontransient dwelling unit H/ERVs from the Mandatory path to the Prescriptive path, first costs may be reduced for some projects where H/ERVs are currently mandated. For other projects that are not currently required to have H/ERVs in the prescriptive path, would not normally install H/ERVs, and for which this proposal introduces new prescriptive path requirements, the first could increase. As explained in the rationale, however, where new requirements are introduced by this proposal, they have been vetted by ASHRAE 90.1 and shown to be cost effective based on energy savings over the useful life of the equipment. A detailed explanation of costs and benefits associated with this proposal can be found with this link:
<https://www.dropbox.com/sh/tbjpbqyz2tccqlk/AADJUnPOlwumQVcJJJeVGjsNoa?dl=0>.

CE133-19

IECC: SECTION C202 (New), C403.7.4, C403.7.4.1(New), C403.7.4.2(New)

Proponent: Connor Barbaree, representing ASHRAE (cbarbaree@ashrae.org)

2018 International Energy Conservation Code

SECTION C202 GENERAL DEFINITIONS

Add new definition as follows:

ENTHALPY RECOVERY RATIO. Change in the enthalpy of the outdoor air supply divided by the difference between the outdoor air and entering exhaust air enthalpy, expressed as a percentage.

Add new text as follows:

C403.7.4 Energy Recovery Systems. Energy recovery ventilation systems shall be provided as specified in either Section 403.7.1 or 403.7.2, as applicable.

C403.7.4.1 Nontransient dwelling units (Prescriptive). Nontransient dwelling units shall be provided with outdoor air energy recovery ventilation systems with an enthalpy recovery ratio of not less than 50 percent at cooling design condition and not less than 60 percent at heating design condition.

Exceptions:

1. Nontransient dwelling units in Climate Zone 3C.
2. Nontransient dwelling units with no more than 500 square feet (46 m²) of conditioned floor area in Climate Zones 0, 1, 2, 3, 4C, and 5C.
3. Enthalpy recovery ratio requirements at heating design condition in Climate Zones 0, 1, and 2.
4. Enthalpy recovery ratio requirements at cooling design condition in Climate Zones 4, 5, 6, 7, and 8.

Revise as follows:

~~C403.7.4 C403.7.4.2 Energy recovery ventilation systems~~ **Spaces other than nontransient dwelling units (Mandatory).** Where the supply airflow rate of a fan system serving a space other than a nontransient dwelling unit exceeds the values specified in Tables C403.7.4(1) and C403.7.4(2), the system shall include an energy recovery system. The energy recovery system shall ~~be configured to provide a change in the enthalpy of the outdoor air supply~~ provide an enthalpy recovery ratio of not less than 50 percent of the difference between the outdoor air and return air enthalpies, at design conditions. Where an air economizer is required, the energy recovery system shall include a bypass or controls that permit operation of the economizer as required by Section C403.5.

Exception: An energy recovery ventilation system shall not be required in any of the following conditions:

1. Where energy recovery systems are prohibited by the International Mechanical Code .
2. Laboratory fume hood systems that include not fewer than one of the following features:
 - 2.1. Variable-air-volume hood exhaust and room supply systems configured to reduce exhaust and makeup air volume to 50 percent or less of design values.

- 2.2. Direct makeup (auxiliary) air supply equal to or greater than 75 percent of the exhaust rate, heated not warmer than 2°F (1.1°C) above room setpoint, cooled to not cooler than 3°F (1.7°C) below room setpoint, with no humidification added, and no simultaneous heating and cooling used for dehumidification control.
3. Systems serving spaces that are heated to less than 60°F (15.5°C) and that are not cooled.
4. Where more than 60 percent of the outdoor heating energy is provided from site-recovered or site-solar energy.
5. ~~Heating energy~~ Enthalpy recovery ratio requirements in Climate Zones 0, 1 and 2.
6. ~~Cooling energy~~ Enthalpy recovery ratio requirements in Climate Zones 3C, 4C, 5B, 5C, 6B, 7 and 8.
7. Systems requiring dehumidification that employ energy recovery in series with the cooling coil.
8. Where the largest source of air exhausted at a single location at the building exterior is less than 75 percent of the design outdoor air flow rate.
9. Systems expected to operate less than 20 hours per week at the outdoor air percentage covered by Table C403.7.4(1).
10. Systems exhausting toxic, flammable, paint or corrosive fumes or dust.
11. Commercial kitchen hoods used for collecting and removing grease vapors and smoke.

Reason: This proposal aligns ASHRAE 90.1 and the IECC requirements for energy recovery ventilation systems by:

- 1) Changing the specification of energy recovery ventilation systems from Mandatory to Prescriptive, and
- 2) Adding minimum prescriptive path requirements for nontransient* dwelling unit H/ERVs in the prescriptive path, where cost effective.

*Based on the IBC definition of “transient”, “nontransient” dwelling units are those that are occupied for more than 30 days; this term carries the same meaning as used in Section 310 of the 2018 IBC.

Prior to the publication of addendum ay to ASHRAE 90.1-2017, both 90.1 and IECC Section C403.7.4 contained energy recovery ventilation requirements that were developed without consideration given for dwelling units within the scope of 90.1 and the IECC. In an effort to develop rational energy recovery ventilation requirements for nontransient dwelling units, 90.1 considered building energy simulations that were conducted on a nominal 1000 ft², 2-bedroom apartment in compliance with the prescriptive path of 90.1 across all climate zones. Four ventilation systems were evaluated for outdoor air: exhaust-only, dedicated supply, central fan integrated supply, and balanced with energy recovery. Ventilation rates were set in accordance with the minimum permitted by ASHRAE 62.2 (comparable to 2018 IMC minimum requirements for mechanical ventilation of high-rise dwelling units). Simulations were run in EnergyPlus. A list of detailed inputs and outputs is also provided in a separate Excel file, with a narrative available in a PowerPoint document. The simulations and accompanying economic analysis resulted in a very favorable scalar ratio (ASHRAE 90.1’s metric for cost effectiveness**) for dwelling unit energy recovery ventilation systems in all climate zones except for 3C for typical dwelling units and except for climate zones 0B, 1, 2, 3, 4C, and 5C for small dwelling units (i.e., no more than 500 ft²). Additionally, the proposal exempts all dwelling units in climate zones 0, 1, 2, and 3C from heating energy recovery requirements and climate zones 3C, 4, 5, 6, 7, and 8 from cooling energy recovery requirements based on insignificant savings. This proposal to the IECC mirrors what was vetted and developed over several months by ASHRAE Technical Committee TC5.5 prior to submitting to the 90.1 Mechanical Subcommittee and ultimately approved as addendum ay by the full 90.1 committee.

**A “favorable scalar” is 12.5 or less for heat exchangers with an expected life of 15 years. The economic analysis behind 90.1 addendum ay and this proposal showed an average scalar of 2.9 for the 1008 ft² apartment across all climate zones, and an average of 9.3 for the 500 ft² apartment across all climate zones but

the exempted climate zones 0, 1, 2, 3, 4C, and 5C.

For an overview of ASHRAE 90.1's economic model and the scalar method, a presentation summarizing the building energy simulations supporting ASHRAE 90.1 addendum ay and this proposal, and an Excel workbook with the building energy simulation inputs, results, and economic analysis, see this link:
<https://www.dropbox.com/sh/tbjpbqyz2tccqlk/AADJUnPOLwumQVcJJeVGjsNoa?dl=0>.

Bibliography: Addendum AY to 90.1-2016.

Cost Impact: The code change proposal will increase the cost of construction. By moving the requirement for H/ERVs from the Mandatory path to the Prescriptive path, first costs may be reduced for some projects. For other projects that are not currently required to have H/ERVs in the prescriptive path, would not normally install H/ERVS, and for which this proposal introduces new prescriptive path requirements, the first cost will increase. As explained in the rationale, however, where new requirements are introduced by this proposal, they have been vetted by ASHRAE 90.1 and shown to be cost effective based on energy savings over the useful life of the equipment and a favorable scalar ratio. A detailed explanation of costs and benefits associated with this proposal can be found with this link:
<https://www.dropbox.com/sh/tbjpbqyz2tccqlk/AADJUnPOLwumQVcJJeVGjsNoa?dl=0>.

Proposal # 4865

CE133-19

CE134-19

IECC: C403.7.5 (New), TABLE C403.7.5 (New)

Proponent: Guy McMann, Jefferson County, Colorado, representing Colorado Association of Plumbing and Mechanical Officials (CAPMO) (gmcmann@jeffco.us)

2018 International Energy Conservation Code

Delete without substitution:

~~C403.7.5 Kitchen exhaust systems (Mandatory).~~ Replacement air introduced directly into the exhaust hood cavity shall not be greater than 10 percent of the hood exhaust airflow rate. Conditioned supply air delivered to any space shall not exceed the greater of the following:

- ~~1. The ventilation rate required to meet the space heating or cooling load.~~
- ~~2. The hood exhaust flow minus the available transfer air from adjacent space where available transfer air is considered to be that portion of outdoor ventilation air not required to satisfy other exhaust needs, such as restrooms, and not required to maintain pressurization of adjacent spaces.~~

~~Where total kitchen hood exhaust airflow rate is greater than 5,000 cfm (2360 L/s), each hood shall be a factory-built commercial exhaust hood listed by a nationally recognized testing laboratory in compliance with UL 710. Each hood shall have a maximum exhaust rate as specified in Table C403.7.5 and shall comply with one of the following:~~

- ~~1. Not less than 50 percent of all replacement air shall be transfer air that would otherwise be exhausted.~~
- ~~2. Demand ventilation systems on not less than 75 percent of the exhaust air that are configured to provide not less than a 50 percent reduction in exhaust and replacement air system airflow rates, including controls necessary to modulate airflow in response to appliance operation and to maintain full capture and containment of smoke, effluent and combustion products during cooking and idle.~~
- ~~3. Listed energy recovery devices with a sensible heat recovery effectiveness of not less than 40 percent on not less than 50 percent of the total exhaust airflow.~~

~~Where a single hood, or hood section, is installed over appliances with different duty ratings, the maximum allowable flow rate for the hood or hood section shall be based on the requirements for the highest appliance duty rating under the hood or hood section.~~

Exception: ~~Where not less than 75 percent of all the replacement air is transfer air that would otherwise be exhausted.~~

TABLE C403.7.5
MAXIMUM NET EXHAUST FLOW RATE, CFM PER LINEAR FOOT OF HOOD LENGTH

TYPE OF HOOD	LIGHT-DUTY EQUIPMENT	MEDIUM-DUTY EQUIPMENT	HEAVY-DUTY EQUIPMENT	EXTRA-HEAVY-DUTY EQUIPMENT
Wall-mounted canopy	140	210	280	385
Single-island	280	350	420	490

Double island (per side)	175	210	280	385
Eyebrow	175	175	NA	NA
Backshelf/Pass- over	210	210	280	NA

For SI: 1 cfm = 0.4719 L/s; 1 foot = 305 mm.

NA = Not Allowed.

Reason: These sections are inconsistent with the IMC and was never coordinated for the last two cycles. This requirement is also a job killer in that non-710 hoods over 5000 cfm can no longer be constructed where the IMC still permits it. This does nothing to help the economy whatsoever. This has created a tremendous conflict between the two codes. The unintended consequence is that it results in the inability to re-locate a non-710 hood over 5000 cfm to a new location even though it was lawfully installed at the time. Whats the logic in tossing a perfectly good system and having to spend thousands of dollars to replace it. The table is already in the IMC where it belongs and not in the IECC. Yes a 710 hood moves less air than a non-listed hood but the savings will never be realized if a new system has to be employed. This will eliminate the ability to build a custom hood if a designer so chose to do so. The cost of this code section presents an unfair burden on the owners. This subject matter belongs in the IMC, not the IECC.

Cost Impact: The code change proposal will decrease the cost of construction
Not having to toss a perfectly good system will decrease cost.

Proposal # 4119

CE134-19

CE135-19

IECC: SECTION C202, C403.7.6.1, C403.7.6.2

Proponent: Connor Barbaree, representing ASHRAE (cbarbaree@ashrae.org)

2018 International Energy Conservation Code

SECTION C202 GENERAL DEFINITIONS

Revise as follows:

NETWORKED GUESTROOM CONTROL SYSTEM. A control system, accessible from the front desk or other central location associated with a *Group R-1* building, that is capable of identifying the ~~occupancy~~ rented and unrented status of each guestroom according to a timed schedule, and is capable of controlling HVAC in each hotel and motel guestroom separately.

C403.7.6 Automatic control of HVAC systems serving guestrooms (Mandatory). In *Group R-1* buildings containing more than 50 guestrooms, each guestroom shall be provided with controls complying with the provisions of Sections C403.7.6.1 and C403.7.6.2. Card key controls comply with these requirements.

C403.7.6.1 Temperature setpoint controls. Controls shall be provided on each HVAC system that are capable of and configured with three modes of temperature control.

1. When the guest room is rented but unoccupied, the controls shall ~~to~~ automatically raise the cooling setpoint and lower the heating setpoint by not less than 4°F (2°C) from the occupant setpoint within 30 minutes after the occupants have left the guestroom.
2. When the guest room is unrented and unoccupied, the controls shall ~~The controls shall be capable of and configured to~~ automatically raise the cooling setpoint to not lower than 80°F (27°C) and lower the heating setpoint to not higher than 60°F (16°C) ~~when the guestroom is unrented or has not been continuously occupied for more than 16 hours or~~ . Unrented and unoccupied guest room mode shall be initiated within 16 hours of the guest room being continuously occupied or where a networked guestroom control system indicates that the guestroom is unrented and the guestroom is unoccupied for more than 30 20 minutes. A networked guestroom control system that is capable of returning the thermostat setpoints to default occupied setpoints 60 minutes prior to the time a guestroom is scheduled to be occupied is not precluded by this section. Cooling that is capable of limiting relative humidity with a setpoint not lower than 65-percent relative humidity during unoccupied periods is not precluded by this section.
3. When the guest room is occupied, HVAC set points shall return to their occupied set points once occupancy is sensed.

C403.7.6.2 Ventilation controls. Controls shall be provided on each HVAC system that are capable of and configured to automatically turn off the ventilation and exhaust fans within ~~30 20~~ minutes of the occupants leaving the guestroom, or *isolation devices* shall be provided to each guestroom that are capable of automatically shutting off the supply of outdoor air to and exhaust air from the guestroom.

Exception: Guestroom ventilation systems are not precluded from having an automatic daily pre-occupancy purge cycle that provides daily outdoor air ventilation during unrented periods at the design ventilation rate for 60 minutes, or at a rate and duration equivalent to one air change.

Reason: This addendum contains minor changes to language for clarification. Original language could be interpreted to allow room lighting and HVAC to resume after 30 minutes of unoccupied and unrented condition. Changes include:

1. The guest room temperature controls subsection is reorganized to clarify that there are three distinct modes of operation.
2. The definition of networked guest room control system is modified to be consistent with the requirements.
3. The time-out period for unoccupied indication is changed from 30 minutes to 20 minutes for consistency between HVAC and the lighting control in Section C405.2.1.1.

Bibliography: Addendum *k* to ASHRAE standard 90.1-2016

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. The language changes are intended to be clarifications only.

Proposal # 4898

CE135-19

CE136-19

IECC: SECTION C202 (New), C403.8.2

Proponent: Connor Barbaree, representing ASHRAE (cbarbaree@ashrae.org)

2018 International Energy Conservation Code

SECTION C202 GENERAL DEFINITIONS

Add new definition as follows:

FAN NAMEPLATE ELECTRICAL INPUT POWER. The nominal electrical input power rating stamped on a fan assembly nameplate.

Revise as follows:

C403.8.2 Motor nameplate horsepower (Mandatory). For each fan, the fan brake horsepower shall be indicated on the construction documents and the selected motor shall be not larger than the first available motor size greater than the following:

1. For fans less than 6 bhp (~~4413~~ 4476 W), 1.5 times the fan brake horsepower.
2. For fans 6 bhp (~~4413~~ 4476 W) and larger, 1.3 times the fan brake horsepower.

Exception Exceptions:

1. Fans equipped with electronic speed control devices to vary the fan airflow as a function of load
2. Fans with a fan nameplate electrical input power of less than .89 kW.
3. Systems complying with Section C403.8.1 fan system motor nameplate hp (Option 1).
4. Fans with motor nameplate horsepower less than 1 hp (746 W) ~~are exempt from this section.~~

Reason: 1. This proposal corrects an IP / SI conversion error related to shaft power: 6 bhp equals 4476 W mechanical power.

2. It proposes moving the clause about *fan system motor nameplate* into the exceptions section for better clarity.

3. This proposal increases the design options for load-matching variable-speed fan motors, accommodates new motor and drive technologies, and it simplifies the motor selection criteria for fans.

Only motors that are government regulated in terms of test procedure and labeling have verifiable output power rating on the nameplates. None-covered motor types that are common for fans are air-over rated motors and electronically commutated permanent magnet motors. All other advanced motor topologies also prevent straight-forward motor output power ratings.

Related ASHRAE 90.1 interpretations are 90.1-2013-11 and 90.1-2016-3 of January 29, 2017, 90.1-2013-13 of June 25, 2017.

Even the nameplate output power rating of government regulated motors is irrelevant when the fan design duty

requires variable frequency drive operation below 60 Hz. Then the motor horsepower must be oversized to deliver the required torque.

AC induction motors operated with variable frequency drives maintain high efficiency at part load. Permanent magnet fan motors maintain even higher efficiency. For all so-called power drive applications exists a self-regulating effect because of the higher marginal cost of oversized combinations of drives and motors as opposed to oversized induction motors for across-the-line operation. The existing restriction of motor selections provides no benefits in the case of fans with electronic variable-speed controls.

Small fans especially are often supplied strictly with electrical input power ratings rather than motor output power ratings. A lower limit expressed in electrical input power is therefore needed. The original 1 hp motor nameplate output power limit equates to 0.89 kW electrical motor input power according to the reference motor in ANSI/AMCA 208.

Bibliography:

- ANSI/AMCA 208 Calculation of the Fan Energy Index
https://www.techstreet.com/standards/amca-208-18?product_id=2004773
Courtesy copy available for the IECC committee through AMCA.
- The term “power drive system” is established in IEC 61800 and in ANSI/ASHRAE standard 222.

Cost Impact: The code change proposal will not increase or decrease the cost of construction. It removes restrictions for fan selections with electronic power drive systems such as variable frequency drives and electronically committed motors.

Proposal # 4869

CE136-19

CE137-19

IECC: (New), C403.8.3, AMCA Chapter 06 (New)

Proponent: Amanda Hickman, The Hickman Group, representing AMCA International
(amanda@thehickmangroup.com)

2018 International Energy Conservation Code

Add new definition as follows:

FAN, EMBEDDED. A fan that is part of a manufactured assembly where the assembly includes functions other than air movement.

FAN ARRAY. Multiple fans in parallel between two plenum sections in an air distribution system.

FAN ENERGY INDEX (FEI) The ratio of the electric input power of a reference fan to the electric input power of the actual fan as calculated in accordance with AMCA 208.

FAN NAMEPLATE ELECTRICAL INPUT POWER The nominal electrical input power rating stamped on a fan assembly nameplate.

FAN SYSTEM ELECTRICAL INPUT POWER. The sum of the fan electrical power of all fans that are required to operate at fan system design conditions to supply air from the heating or cooling source to the conditioned spaces and/or return it to the source or exhaust it to the outdoors.

Delete and substitute as follows:

~~**C403.8.3 Fan efficiency (Mandatory).** Fans shall have a fan efficiency grade (FEG) of not less than 67, as determined in accordance with AMCA 205 by an approved, independent testing laboratory and labeled by the manufacturer. The total efficiency of the fan at the design point of operation shall be within 15 percentage points of the maximum total efficiency of the fan.~~

~~**Exception:** The following fans are not required to have a fan efficiency grade:~~

- ~~1. Fans of 5 hp (3.7 kW) or less as follows:
 - ~~1.1. Individual fans with a motor nameplate horsepower of 5 hp (3.7 kW) or less, unless Exception 1.2 applies.~~
 - ~~1.2. Multiple fans in series or parallel that have a combined motor nameplate horsepower of 5 hp (3.7 kW) or less and are operated as the functional equivalent of a single fan.~~~~
- ~~2. Fans that are part of equipment covered in Section C403.3.2.~~
- ~~3. Fans included in an equipment package certified by an approved agency for air or energy performance.~~
- ~~4. Powered wall/roof ventilators.~~
- ~~5. Fans outside the scope of AMCA 205.~~
- ~~6. Fans that are intended to operate only during emergency conditions.~~

C403.8.3 Fan efficiency (Mandatory). Each fan and fan array shall have a fan energy index (FEI) of not less than 1.00 at the design point of operation, as determined in accordance with AMCA 208 by an approved, independent testing laboratory and labeled by the manufacturer. Each fan and fan array used for a variable-air-volume system shall have an FEI of not less than 0.95 at the design point of operation as determined in

accordance with AMCA 208 by an approved, independent testing laboratory and labeled by the manufacturer. The FEI for fan arrays shall be calculated in accordance with Annex C of AMCA 208.

Exceptions: The following fans are not required to have a fan energy index:

1. Fans that are not embedded fans with motor nameplate horsepower of less than 1.0 hp (0.75 kW) or less with a fan nameplate electrical input power of less than 0.89 kW.
2. Embedded fans that have a motor nameplate horsepower of 5 hp (3kW) or less or with a fan system electrical input power of 4.1 kW or less.
3. Multiple fans operated in series or parallel as the functional equivalent of a single fan that have a combined motor nameplate horsepower of 5 hp (3.7 kW) or less or with a fan system electrical input power of 4.1 kW or less.
4. Fans that are part of equipment covered in Section C403.3.2.
5. Fans included in an equipment package certified by an approved agency for air or energy performance.
6. Ceiling fans, i.e., non portable devices suspended from a ceiling or overhead structure for circulating air via the rotation of fan blades.
7. Fans used for moving gases at temperatures above 482°F (250°C)
8. Fans used for operation in explosive atmospheres.
9. Reversible fans used for tunnel ventilation.
10. Fans that are intended to operate only during emergency conditions.
11. Fans outside the scope of AMCA 208.

Add new standard(s) as follows:

AMCA

Air Movement and Control
Association International
30 West University Drive
Arlington Heights IL 60004-1806

208-18: Calculation of the Fan Energy Index

Reason: This proposal updates the current fan efficiency metric from a Fan Efficiency Grade (FEG) to a more current and improved metric known as Fan Energy Index (FEI). It also updates terms in the definitions chapter. This proposal also updates the definitions and associated standards for this new metric.

In the course of a U.S. Department of Energy (DOE) rulemaking for commercial fans and blowers, a wire-to-air metric was deemed to be more effective at saving energy because it would consider the impacts of motors and drives on fan energy performance. Although DOE has since stalled the fan rulemaking, the State of California has initiated an efficiency regulation for commercial and industrial fans under its Title 20 appliance/equipment efficiency standard.

Stemming from a public negotiation of fan-industry stakeholders (manufacturers, efficiency advocates,

consulting engineers, and a DOE representative), the Fan Energy Index (FEI), was developed by AMCA International and member companies, working collaboratively with efficiency advocates and DOE. FEI is defined in the calculation standard, ANSI/AMCA 208-2018.

Energy savings will primarily result from better fan selections out of existing product portfolios rather than marginal improvements from costly fan redesigns. FEI incentivizes a good match of the fan with its mechanical drive and the electric motor even at part load. The fan velocity pressure is credited in the FEI metric for fans with ducted outlets. Velocity pressure is not included for fans with unducted outlets.\

The lower scope limit is expressed in nameplate motor output power and in nameplate fan electrical input power because only the former is available for some fans and for others only the latter. The conversion from motor output power to fan input power uses the reference motor efficiency curve fit from AMCA 208.

FEI will be easier to enforce over FEG because language requiring that fans be selected “15-percentage points from peak total efficiency” is no longer needed. Also, FEI applies to all types of fans, so the exclusions for PRVs and panel fans go away, bringing a fan-efficiency requirement to more fans than previously covered.

Bibliography: Title: New Federal Regulations for Ceiling Fans
Authors: New Federal Regulations for Ceiling Fans

Published: ASHRAE Journal, January 2018

File: 42-46_Taber-Ivanovich_Fans, for Web.pdf

Keywords: large diameter, ceiling fans, efficiency, performance, U.S. Department of Energy, DOE, AMCA Standard 230, AMCA Standard 208, fan energy index, FEI

Abstract: In January 2017, the U.S. Department of Energy (DOE) finalized its first efficiency performance standards for ceiling fans, which include minimum efficiency requirements for large-diameter ceiling fans. Ratings using the DOE test procedure allow comparisons of products based on electric input power and airflow. Because the DOE performance metric is not based on a specific airflow point, some additional effort on the part of the designer may be required to evaluate fan performance equitably at a specific airflow point. Here are four things to know about the DOE's regulation of ceiling fans that will help to ensure a successful and efficient ceiling-fan selection.

Revolutionary Method of Saving Energy for Commercial and Industrial Fan Systems, Michael Ivanovich, Mark Bublitz, and Tim Mathson. Presented at the 2017 ACEEE Summer Study for Industrial Energy Efficiency, Denver, Colorado. August 15-18, 2017:

Paper: ACEEE-2017-Paper.pdf

PowerPoint: Bublitz FEI ACEEE Industrial EE 2017 presentation.pdf

New Efficiency Metric for Fans Enables New Approaches for Efficiency Regulations and Incentives. Michael Ivanovich, Mike Wolf, Tom Catania. Presented at the 9th International Conference on Energy Efficiency In Domestic Appliances And Lighting (EEDAL), Irvine, California, September 13-15, 2017.

Paper: EEDAL-2017-Paper.pdf

Presentation: AMCA FEI EEDAL 2017 presentation.pdf

AMCA Introduction to Fan Energy Index (FEI) for Stand-Alone Fans. A self-directed 1.5-hour interactive training course. Includes AMCA Standard 208, Calculating Fan Energy Index.

Course link: <https://courses-pes.talentlms.com/catalog/info/id:141>

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

This proposal could, in some cases increase the cost of construction. However, these potential increases are cost effective Moreover, this proposal will result in better fan selections out of existing product portfolios rather than marginal improvements from costly fan redesigns.

Staff Analysis: A review of the standard proposed for inclusion in the code, AMCA 208-18, 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.

Proposal # 4114

CE137-19

CE138-19

IECC: C403.8.3

Proponent: Amanda Hickman, The Hickman Group, representing AMCA International
(amanda@thehickmangroup.com)

2018 International Energy Conservation Code

Delete without substitution:

~~C403.8.3 Fan efficiency (Mandatory).~~ Fans shall have a fan efficiency grade (FEG) of not less than 67, as determined in accordance with AMCA 205 by an ~~approved~~, independent testing laboratory and labeled by the manufacturer. The total efficiency of the fan at the design point of operation shall be within 15 percentage points of the maximum total efficiency of the fan.

~~Exception:~~ The following fans are not required to have a fan efficiency grade:

- ~~1. Fans of 5 hp (3.7 kW) or less as follows:~~
 - ~~1.1. Individual fans with a motor nameplate horsepower of 5 hp (3.7 kW) or less, unless Exception 1.2 applies.~~
 - ~~1.2. Multiple fans in series or parallel that have a combined motor nameplate horsepower of 5 hp (3.7 kW) or less and are operated as the functional equivalent of a single fan.~~
- ~~2. Fans that are part of equipment covered in Section C403.3.2.~~
- ~~3. Fans included in an equipment package certified by an *approved agency* for air or energy performance.~~
- ~~4. Powered wall/roof ventilators.~~
- ~~5. Fans outside the scope of AMCA 205.~~
- ~~6. Fans that are intended to operate only during emergency conditions.~~

Reason: AMCA International and a consensus of its member companies worked through the US DOE and ASHRAE to develop an improved metric for inclusion into the codes. For this reason, this proposal deletes the antiquated metric: Fan Efficiency Grade from this section.

Cost Impact: The code change proposal will not increase or decrease the cost of construction. This will eliminate an outdated requirement, which could decrease the cost of the fan selected for a given application.

Proposal # 4583

CE138-19

CE139-19

IECC: SECTION C202 (New), C403.8.3, Chapter 6CE (New)

Proponent: Connor Barbaree, representing ASHRAE (cbarbaree@ashrae.org)

2018 International Energy Conservation Code

SECTION C202 GENERAL DEFINITIONS

Add new definition as follows:

FAN, EMBEDDED. A fan that is part of a manufactured assembly where the assembly includes functions other than air movement.

FAN ARRAY. Multiple fans in parallel between two plenum sections in an air distribution system.

FAN NAMEPLATE ELECTRICAL INPUT POWER. The nominal electrical input power rating stamped on a fan assembly nameplate.

FAN ENERGY INDEX (FEI). The ratio of the electric input power of a reference fan to the electric input power of the actual fan as calculated in accordance with AMCA 208.

FAN SYSTEM ELECTRICAL INPUT POWER. The sum of the fan electrical power of all fans that are required to operate at fan system design conditions to supply air from the heating or cooling source to the conditioned spaces and/or return it to the source or exhaust it to the outdoors.

Revise as follows:

C403.8.3 Fan efficiency (Mandatory). Fans Each fan and fan array shall have a fan efficiency-grade energy index (FEG-FEI) of not less than ~~67~~ 1.00 at the design point of operation, as determined in accordance with AMCA 205 208 by an *approved*, independent testing laboratory and labeled by the manufacturer. ~~The total efficiency of the fan~~ Each fan and fan array used for a variable-air-volume system shall have an FEI of not less than 0.95 at the design point of operation ~~shall be within 15 percentage points of the maximum total efficiency of the fan, as determined in accordance with AMCA 208 by an approved, independent testing laboratory and labeled by the manufacturer. The FEI for fan arrays shall be calculated in accordance with AMCA 208 Annex C.~~

Exceptions Exception: The following fans are not required to have a fan efficiency-grade energy index:

1. Fans that are not embedded fans with motor nameplate horsepower of less than 1.0 hp (0.75 kW) or with a nameplate electrical input power of less than 0.89 kW.
2. Embedded fans that have 1. Fans of 5 hp (3.7 kW) or less as follows: 1.1. Individual fans with a motor nameplate horsepower of 5 hp (3.7 kW) or less, unless Exception 1.2 applies; or with a fan system electrical input power of 4.1 kW or less.
3. Multiple fans operated 1.2. Multiple fans in series or parallel as the functional equivalent of a single fan that have a combined motor nameplate horsepower of 5 hp (3.7 kW) or less and are operated as the functional equivalent of a single fan, or with a fan system electrical input power of 4.1 kW or less.
- 4.2. Fans that are part of equipment covered in Section C403.3.2.
- 5.3. Fans included in an equipment package certified by an *approved agency* for air or energy performance.

- ~~4. Powered wall/roof ventilators.~~
- ~~5. Fans outside the scope of AMCA 205.~~
6. Ceiling fans, i.e., nonportable devices suspended from a ceiling or overhead structure for circulating air via the rotation of the blades.
7. Fans used for moving gases at temperatures above 425°F (250 °C).
8. Fans used for operation in explosive atmospheres.
9. Reversible fans used for tunnel ventilation.
- ~~10.6. Fans that are intended to operate only during emergency conditions.~~
11. Fans outside the scope of AMC208.

AMCA

Air Movement and Control
Association International
30 West University Drive
Arlington Heights IL 60004-1806

208-18: Calculation of the Fan Energy Index

Reason: This proposal harmonizes the recent revisions in Addendum ao of ASHRAE 90.1, which will be in the 2019 edition of the standard. Replacing the Fan Efficiency Grade (FEG) metric with Fan Energy Index (FEI) will result in a more effective energy savings metric and updates the corresponding definitions and standard. FEI was developed in response to the U.S. Department of Energy (DOE) rulemaking for commercial fans and blowers, whereby a wire-to-air metric was deemed to be more effective at saving energy because it would consider the impacts of motors and drives on fan energy performance. Although DOE has since stalled the fan rulemaking, the State of California has initiated an efficiency regulation for commercial and industrial fans under its Title 20 appliance/equipment efficiency standard. FEI has been added to the DOE EnergyPlus software and to the DOE Fan System Assessment Tool. Unlike FEG, FEI can be used in calculations for energy savings, and it does not require a “sizing/selection window,” which makes enforcement easier.

Bibliography: 1. Title: New Federal Regulations for Ceiling Fans: What You Need to Know
Authors: Christian Taber; Michael Ivanovich

Published: ASHRAE Journal, January 2018

File: 42-46_Taber-Ivanovich_Fans, for Web.pdf

Link: www.amca.org/resources/documents/42-46_Taber-Ivanovich_Fans,%20for%20Web.pdf

Keywords: large diameter, ceiling fans, efficiency, performance, U.S. Department of Energy, DOE, AMCA Standard 230, AMCA Standard 208, fan energy index, FEI

Abstract: In January 2017, the U.S. Department of Energy (DOE) finalized its first efficiency performance standards for ceiling fans, which include minimum efficiency requirements for large-diameter ceiling fans. Ratings using the DOE test procedure allow comparisons of products based on electric input power and airflow. Because the DOE performance metric is not based on a specific airflow point, some additional effort on the part of the designer may be required to evaluate fan performance equitably at a specific airflow point. Here are four things to know about the DOE's regulation of ceiling fans that will help to ensure a successful and efficient ceiling-fan selection.

2. Title: Revolutionary Method of Saving Energy for Commercial and Industrial Fan Systems,

Authors: Michael Ivanovich, Mark Bublitz, and Tim Mathson. Presented at the 2017 ACEEE Summer Study for

Industrial Energy Efficiency, Denver, Colorado. August 15-18, 2017:

Paper: ACEEE-2017-Paper.pdf

Link: www.amca.org/resources/documents/ACEEE-2017-Paper.pdf

PowerPoint: Bublitz FEI ACEEE Industrial EE 2017 presentation.pdf

Link:

www.amca.org/resources/documents/Bublitz%20FEI%20ACEEE%20Industrial%20EE%202017%20presentation.pdf

3. Title: New Efficiency Metric for Fans Enables New Approaches for Efficiency Regulations and Incentives.

Authors: Michael Ivanovich, Mike Wolf, Tom Catania.

Presented at the 9th International Conference on Energy Efficiency In Domestic Appliances And Lighting (EEDAL), Irvine, California, September 13-15, 2017.

Paper: EEDAL-2017-Paper.pdf

Link: www.amca.org/resources/documents/EEDAL-2017-Paper.pdf

Presentation: AMCA FEI EEDAL 2017 presentation.pdf

Link: www.amca.org/resources/documents/AMCA%20FEI%20EEDAL%202017%20presentation.pdf

4. AMCA Introduction to Fan Energy Index (FEI) for Stand-Alone Fans. A self-directed 1.5-hour interactive training course. Includes AMCA Standard 208, Calculating Fan Energy Index.

Course link: <https://courses-pes.talentlms.com/catalog/info/id:141>

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

This proposal may increase the cost of some construction. However, it is a cost-effective change resulting in more efficient fan selection with proven economic payback and positive return on investment.

Staff Analysis: A review of the standard proposed for inclusion in the code, AMCA 208-18, 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.

Analysis: A review of the standard proposed for inclusion in the code, AMCA 208, 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.

Proposal # 4866

CE139-19

CE140-19

IECC: C403.8.5 (New), TABLE C403.8.5 (New)

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

Add new text as follows:

C403.8.5 Low-capacity ventilation fans. Mechanical ventilation system fans with motors less than 1/12 horsepower in capacity shall meet the efficacy requirements of Table C403.8.5.

Exceptions:

1. Where ventilation fans are a component of a listed heating or cooling appliance.
2. Dryer exhaust duct power ventilators, domestic range hoods, and domestic range booster fans that operate intermittently.

TABLE C403.8.5
LOW-CAPACITY VENTILATION FAN EFFICACY

<u>FAN LOCATION</u>	<u>AIR FLOW RATE MINIMUM</u>	<u>MINIMUM EFFICACY</u>	<u>AIR FLOW RATE MAXIMUM</u>
	<u>(CFM)</u>	<u>(CFM/WATT)</u>	<u>(CFM)</u>
<u>HRV or ERV</u>	<u>Any</u>	<u>1.2 cfm/watt</u>	<u>Any</u>
<u>In-line fan</u>	<u>Any</u>	<u>3.8 cfm/watt</u>	<u>Any</u>
<u>Bathroom, utility room</u>	<u>10</u>	<u>2.8 cfm/watt</u>	<u>< 90</u>
<u>Bathroom, utility room</u>	<u>90</u>	<u>3.5 cfm/watt</u>	<u>Any</u>

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 \geq 0.2 in. w.c. Fan efficacy for range hoods, bathroom, and utility room fans shall be taken at a static pressure \geq 0.1 in. w.c.

Reason: Exhaust fan efficacies were introduced in the code in 2012 IECC for whole-house ventilation in low-rise residential buildings, but have never been included in the commercial provisions of the IECC. Mid-rise residential occupancies and small commercial buildings often utilize the same small ventilation fans leaving a loophole for a common energy load. These fans are used for point-of-source contaminant exhaust and are frequently utilized as part of a ventilation strategy in multifamily buildings. These fans are also smaller than the threshold for fan size (1/12 HP) that is attached to the other commercial fan requirements. This makes them a common load, and a potentially significant load in multifamily buildings, that is completely unregulated in commercial buildings.

This proposal adopts the table approach already utilized for these fans in the residential section of the code. However, it updates the efficiency requirements. The current residential IECC fan efficacies are from an older version of Energy Star (Version 2.0), so these have been updated to align the latest Energy Star requirement Version 4.0. These fan efficacy values are very conservative based on what is currently on the market.

It sets the efficiency requirement at a level that can reasonably be met by a large number of products available on the market. According to the HVI database of fans, the average efficiency of bath fans is around 7 CFM/W, and the average efficiency of in-line fans is 3.1. This proposal, therefore, places the requirement far below the

market average efficiency for bath fans and close to the market average for in-line fans, making this a reasonable requirement.

Another proposal has been submitted to the residential section of the code to update those fan efficacy requirements to the same levels.

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

The proposal could increase the cost of construction. Cost for the kinds of fans covered by this requirement are not driven solely by efficacy. Cost is also a function of flow rate, finishes, design and noise and whether they include other features like lights, sensors, or heaters. In some cases, fans that meet this requirement can be obtained for less other fans that do not. Nevertheless, a comparison of the low-cost exhaust fans shows that this proposal can result in no incremental first costs or short simple paybacks where incremental costs are incurred.

For example, no-frills bath fans from major manufacturers moving a minimum of 50 to ~100 cfm at 0.25" w.c. have an immediate payback (i.e., no cost premium) or a simple payback estimated at ≤6 years where there is a cost premium (see Tables 1 and 2). The 2021 IRC requires exhaust fans to be rated at a static pressure of 0.25" w.c., which is widely recognized as a typical installed static pressure found in bath fan exhaust ducts.

Table 1. Lowest cost exhaust fans for major manufacturers having a flow rate ≥ 50 cfm and < 90 cfm at 0.25" w.c.:

Fan	Efficacy at 0.1" w.c.	Flow at 0.25" w.c.	Price Premium by Manufacturer	Simple Payback (years)
AirKing BFQ75 (compliant with proposal)	3.0	70	--	N/A
AirKing AS70 (entry-level at 0.25" w.c.)	1.4	62	\$11.02	6
Broan AE80B (compliant with proposal)	3.0	60	--	N/A
Broan A70L (entry-level at 0.25" w.c.)	1.7	60	\$1.61	1
DeltaBreeze SLM70 (entry-level at 0.25" w.c. is compliant with proposal)	4.7	54	--	immediate

*Simple payback assumes \$0.1178/kWh (DOE EIA national average for residential and commercial), 1-hour of operation per day. Pricing sourced from homedepot.com on 1/9/2019. For Delta, the lowest price fan having at flow rate ≥ 50 cfm and < 90 cfm at 0.25" w.c. also had a fan efficacy meeting the proposed value, so there is no price premium associated with the manufacturer's lowest cost product, and payback is "immediate".

Table 2. Lowest cost exhaust fans for major manufacturers having a flow rate ≥ 90 cfm at 0.25" w.c.:

Fan	Efficacy at 0.1" w.c.	Flow at 0.25" w.c.	Price Premium by Manufacturer	Simple Payback (years)
AirKing BFQ140 (entry-level at 0.25" w.c.)	1.6	109	--	N/A
AirKing AK110LS (compliant with proposal)	3.9	90	\$48.32	6
Broan AN110 (entry-level at 0.25" w.c.)	2.3	102	--	N/A
Broan AEN110 (compliant with proposal)	4.7	92	\$41.09	6
DeltaBreeze VFB25AEH (entry-level at 0.25" w.c.)	5.9	105	--	immediate

is compliant with proposal) Panasonic FV-08-11VFS (entry-level at 0.25" w.c. is compliant with proposal)	4.2	104	--	immediate
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*Simple payback assumes \$0.1178/kWh (DOE EIA national average for residential and commercial), 4-hours of operation per day (higher run time associated with assumption that higher flow rate bath fans are more likely to be installed in commercial bathrooms which are more likely to run continuously or at longer run times than a typical 1-hour residential assumption). Pricing sourced from homedepot.com on 1/9/2019. For some manufacturers, such as Delta and Panasonic, the lowest price fan having at flow rate ≥ 50 cfm and < 90 cfm at 0.25" w.c. also had a fan efficacy meeting the proposed value, so there is no price premium associated with the manufacturer's lowest cost product, and payback is "immediate".

Proposal # 5038

CE140-19

CE141-19

IECC: (New), C403.9 (New), AMCA Chapter 06 (New)

Proponent: Amanda Hickman, The Hickman Group, representing AMCA International and MacroAir (amanda@thehickmangroup.com)

2018 International Energy Conservation Code

Add new definition as follows:

LARGE-DIAMETER CEILING FAN. A ceiling fan that is greater than 7 feet (2134 mm) in diameter. These fans are sometimes referred to as High-Volume, Low-Speed (HVLS) fans.

Add new text as follows:

C403.9 Large-diameter ceiling fans. Where provided, large diameter ceiling fans shall be tested and labeled in accordance with AMCA 230.

Add new standard(s) as follows:

AMCA

Air Movement and Control
Association International
30 West University Drive
Arlington Heights IL 60004-1806

ANSI/AMCA 230-15: Laboratory Methods of Testing Air Circulating Fans for Rating and Certification

Reason: This proposal brings in the definition for large diameter ceiling fans (LDCF) that is consistent with the DOE fan regulations and also the International Mechanical Code. Additionally, this proposal includes language and reference for the appropriate testing standard for these fans **when** they are installed. The addition of this language will be beneficial to the countries and states that adopt the IECC and not the IMC. This section and standard is also needed because language for giving credit for these fans in the performance path was approved into the 2018 IECC last cycle.

Cost Impact: The code change proposal will not increase or decrease the cost of construction. This proposal is not requiring anything new, as the IMC already requires these fans to comply with this standard.

Staff Analysis: A review of the standard proposed for inclusion in the code, AMCA 230-15, 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.

Proposal # 4116

CE141-19

CE142-19

IECC: C403.9.4

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:

C403.9.4 Tower flow turndown. Open-circuit cooling towers used on water-cooled chiller systems that are configured with multiple- or variable-speed condenser water pumps shall be designed so that all open- circuit cooling tower cells can be run in parallel with the larger of the flow that is produced by the smallest pump at its minimum expected flow rate or at 50 percent of the design flow for the cell.

Exception: Cooling towers used during wintertime heat rejection conditions where reducing water flow could cause freezing problems.

Reason: There isn't any need to design a system to operate in a manner under which it can never be operated because of the concern for system damage. Correct system design for an application doesn't result in additional materials or installation labor over that required for an incorrectly designed system that has to be immediately re-worked in the field. In the long run, this proposal will also save money from having to replace parts of the system that are damaged or ruined when the flow becomes so little that the system freezes up and is damaged.

Cost Impact: The code change proposal will not increase or decrease the cost of construction. This change will save money from having to replace parts of the system that are damaged or ruined if the flow is so little it freezes up and damages the system.

Proposal # 5116

CE142-19

CE143-19

IECC: C403.9.6 (New)

Proponent: Connor Barbaree, representing ASHRAE (cbarbaree@ashrae.org)

2018 International Energy Conservation Code

Add new text as follows:

C403.9.6 Heat recovery for space conditioning in healthcare facilities Where heating water is used for space heating, a condenser heat recovery system shall be installed provided all of the following are true:

1. The building is a Group I-2 Condition 2 occupancy
2. The total design chilled water capacity for the Group I-2 Condition 2 occupancy, either air cooled or water cooled, required at cooling design conditions exceeds 3,600,000 Btu/h (1,100 kW) of cooling.
3. Simultaneous heating and cooling occurs above 60°F (16°C) outdoor air temperature.

The required heat recovery system shall have a cooling capacity that is not less than 7 percent of the total design chilled water capacity of the Group I-2 Condition 2 occupancy at peak design conditions.

Exceptions:

1. Buildings that provide 60 percent or more of their reheat energy from on-site renewable energy or site-recovered energy.
2. Buildings in Climate Zones 5C, 6B, 7 and 8.

Reason: Most I-2 Condition 2 occupancies use reheat HVAC systems with simultaneous heating and cooling. Even with required air or water economizers, there are many hours with simultaneous heating and cooling use. It is generally lower cost to generate heating water with a heat recovery chiller or heat pump when the chilled water generated is useful than it is to use a boiler that complies with 90.1.

Evaluation of a typical hospital in multiple climate zones shows a potential for reasonable recovery with a heat recovery chiller or heat pump that is sized between 7% and 12% of the cooling plant, depending on climate zone. For simplification and conservative, the minimum is set at 7% of total cooling load across the board.

An economic analysis was made using the 90.1 scalar method based on installed heat recovery chiller costs of \$1,800 per ton. The resulting paybacks were all under 10 years for required climate zones vs. a scalar limit of 13 years. The trend of higher savings in warmer climate zones was used to include climate zones 1 and 0 without specific analysis. The payback in Climate Zone 2B was under 5 years.

Bibliography: Addendum V to 90.1- 2016

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

The code change proposal will increase the cost of construction due to equipment and infrastructure costs. The payback for such installations is less than 10

years in all required climate zones.

Proposal # 4895

CE143-19

CE144-19

IECC: C402.1, C403.10

Proponent: Ben Edwards, representing Mathis Consulting Co. (ben@mathisconsulting.com)

2018 International Energy Conservation Code

Revise as follows:

C402.1 General (Prescriptive). Building thermal envelope assemblies for buildings that are intended to comply with the code on a prescriptive basis in accordance with the compliance path described in Item 2 of Section C401.2, shall comply with the following:

1. The opaque portions of the building thermal envelope shall comply with the specific insulation requirements of Section C402.2 and the thermal requirements of either the *R*-value-based method of Section C402.1.3; the *U*-, *C*- and *F*-factor-based method of Section C402.1.4; or the component performance alternative of Section C402.1.5.
2. Roof solar reflectance and thermal emittance shall comply with Section C402.3.
3. Fenestration in building envelope assemblies shall comply with Section C402.4.
4. Air leakage of building envelope assemblies shall comply with Section C402.5.

Alternatively, where buildings have a vertical fenestration area or skylight area exceeding that allowed in Section C402.4, the building and building thermal envelope shall comply with Section C401.2, Item 1 or Section C401.2, Item 3.

Walk-in coolers, walk-in freezers, refrigerated warehouse coolers and refrigerated warehouse freezers shall comply with ~~Section C403.10.1 or C403.10.2~~ C403.10.

C403.10 Refrigeration equipment performance. Refrigeration equipment shall have an energy use in kWh/day not greater than the values of Tables C403.10.1(1) and C403.10.1(2) when tested and rated in accordance with AHRI Standard 1200. The energy use shall be verified through certification under an approved certification program or, where a certification program does not exist, the energy use shall be supported by data furnished by the equipment manufacturer.

Exception: Walk-in coolers and walk-in freezers regulated under federal law in accordance with Subpart R of 10 CFR 431.

Reason:

- This change will make enforcement easier for code officials by making explicit that they do not have to address the attributes of walk-in systems preempted by federal requirements.
- The IECC already references 10 CFR for furnaces, boilers, industrial equipment, electric motors, etc., all in similar scenarios (see: Table C403.3.2(5), C403.8.4, Table C404.2, C405.6, etc.).
- No changes to efficiency or definitions have been proposed.
- The references to C403.10.1 and C403.10.2 in C402.1 have been collapsed to reference the relevant parent section, C403.10.
- By providing a reference to the CFR, the guidance of the prescriptive list remains for international users.

The federal standard being referenced is Department of Energy in 10 CFR 431, Subpart R - Walk-in Coolers and Walk-in Freezers - it can be reviewed at this link: <https://www.law.cornell.edu/cfr/text/10/part-431/subpart-R>

Bibliography: General: 10 CFR Part 431, Subpart R - Walk-in Coolers and Walk-in Freezers.

Definitions: 10 CFR 431.302 - Definitions concerning walk-in coolers and walk-in freezers.

Requirements: 10 CFR 431.306 - Energy conservation standards and their effective dates.

Cost Impact: The code change proposal will not increase or decrease the cost of construction. There is no cost impact, because no requirements have been changed; the equipment already is preempted. Potentially, costs could be reduced by avoiding enforcement conflicts.

Proposal # 4770

CE144-19

CE145-19

IECC: C402.1, C403.10.1, C403.10.2, C403.10.2.1, TABLE C403.10.2.1(1), TABLE C403.10.2.1(2), TABLE C403.10.2.1(3), C403.10.4, C405.1

Proponent: Ben Edwards, representing Mathis Consulting Co. (ben@mathisconsulting.com)

2018 International Energy Conservation Code

Revise as follows:

C402.1 General (Prescriptive). Building thermal envelope assemblies for buildings that are intended to comply with the code on a prescriptive basis in accordance with the compliance path described in Item 2 of Section C401.2, shall comply with the following:

1. The opaque portions of the building thermal envelope shall comply with the specific insulation requirements of Section C402.2 and the thermal requirements of either the R-value-based method of Section C402.1.3; the U-, C- and F-factor-based method of Section C402.1.4; or the component performance alternative of Section C402.1.5.
2. Roof solar reflectance and thermal emittance shall comply with Section C402.3.
3. Fenestration in building envelope assemblies shall comply with Section C402.4.
4. Air leakage of building envelope assemblies shall comply with Section C402.5.

Alternatively, where buildings have a vertical fenestration area or skylight area exceeding that allowed in Section C402.4, the building and building thermal envelope shall comply with Section C401.2, Item 1 or Section C401.2, Item 3.

~~Walk-in coolers, walk-in freezers, refrigerated~~ Refrigerated warehouse coolers and refrigerated warehouse freezers shall comply with Section ~~C403.10.1 or C403.10.2~~ C403.10.1.

Delete without substitution:

~~C403.10.1 Walk-in coolers, walk-in freezers, refrigerated warehouse coolers and refrigerated warehouse freezers (Mandatory).~~ ~~Refrigerated warehouse coolers and refrigerated warehouse freezers shall comply with this section. Walk-in coolers and walk-in freezers that are neither site assembled nor site constructed shall comply with the following:~~

- ~~1. Be equipped with automatic door closers that firmly close walk-in doors that have been closed to within 1 inch (25 mm) of full closure.~~

~~**Exception:** Automatic closers are not required for doors more than 45 inches (1143 mm) in width or more than 7 feet (2134 mm) in height.~~

- ~~2. Doorways shall have strip doors, curtains, spring-hinged doors or other method of minimizing infiltration when doors are open.~~
- ~~3. Walk-in coolers and refrigerated warehouse coolers shall contain wall, ceiling, and door insulation of not less than R-25 and walk-in freezers and refrigerated warehouse freezers shall contain wall, ceiling and door insulation of not less than R-32.~~

~~**Exception:** Glazed portions of doors or structural members need not be insulated.~~

- ~~4. Walk-in freezers shall contain floor insulation of not less than R-28.~~
- ~~5. Transparent reach-in doors for walk-in freezers and windows in walk-in freezer doors shall be of triple-pane glass, either filled with inert gas or with heat-reflective treated glass.~~

6. ~~Windows and transparent reach-in doors for walk-in coolers shall be of double-pane or triple-pane, inert gas-filled, heat-reflective treated glass.~~
7. ~~Evaporator fan motors that are less than 1 hp (0.746 kW) and less than 460 volts shall use electronically commutated motors, brushless direct-current motors, or 3-phase motors.~~
8. ~~Condenser fan motors that are less than 1 hp (0.746 kW) shall use electronically commutated motors, permanent split capacitor-type motors or 3-phase motors.~~
9. ~~Where antisweat heaters without antisweat heater controls are provided, they shall have a total door rail, glass and frame heater power draw of not more than 7.1 W/ft² (76 W/m²) of door opening for walk-in freezers and 3.0 W/ft² (32 W/m²) of door opening for walk-in coolers.~~
10. ~~Where antisweat heater controls are provided, they shall reduce the energy use of the antisweat heater as a function of the relative humidity in the air outside the door or to the condensation on the inner glass pane.~~
11. ~~Lights in walk-in coolers, walk-in freezers, refrigerated warehouse coolers and refrigerated warehouse freezers shall either use light sources with an efficacy of not less than 40 lumens per watt, including ballast losses, or shall use light sources with an efficacy of not less than 40 lumens per watt, including ballast losses, in conjunction with a device that turns off the lights within 15 minutes when the space is not occupied.~~

Revise as follows:

C403.10.2 C403.10.1 Walk-in coolers and walk-in Refrigerated warehouse coolers, refrigerated warehouse freezers (Mandatory). ~~Site-assembled or site-constructed walk-in~~ Refrigerated warehouse coolers and walk-in-refrigerated warehouse freezers shall comply with the following:

1. Automatic door closers shall be provided that fully close walk-in doors that have been closed to within 1 inch (25 mm) of full closure.
Exception: Closers are not required for doors more than 45 inches (1143 mm) in width or more than 7 feet (2134 mm) in height.
2. Doorways shall be provided with strip doors, curtains, spring-hinged doors or other method of minimizing infiltration when the doors are open.
3. ~~Walls shall be provided with insulation having a thermal resistance~~ Refrigerated warehouse cooler wall, ceiling, and door insulation shall have an R-value of not less than R-25, ceilings shall be provided with insulation having a thermal resistance of not less than R-25 and doors of walk-in coolers and walk-in freezers shall be provided with insulation having a thermal resistance 25. Refrigerated warehouse freezer wall, ceiling, and door insulation shall have an R-value of not less than R-32. 32.
Exception: Insulation is not required for glazed portions of doors or at structural members associated with the walls, ceiling or door frame.
4. The floor of ~~walk-in-refrigerated warehouse freezers~~ shall be provided with insulation having a thermal resistance of not less than R-28.
5. ~~Transparent Refrigerated warehouse freezer transparent reach-in doors for,~~ and windows in opaque ~~walk-in freezer~~ doors shall be provided with triple-pane glass having the interstitial spaces filled with inert gas or provided with heat-reflective treated glass.
6. ~~Transparent Refrigerated warehouse cooler transparent reach-in doors for,~~ and windows in opaque ~~walk-in cooler~~ doors shall be double-pane heat-reflective treated glass having the interstitial space gas filled.
7. Evaporator fan motors that are less than 1 hp (0.746 kW) and less than 460 volts shall be electronically commutated motors, brushless direct-current motors, or 3-phase motors.
8. Condenser fan motors that are less than 1 hp (0.746 kW) in capacity shall be of the electronically commutated or permanent split capacitor-type or shall be 3-phase motors.

Exception: Fan motors in ~~walk-in-refrigerated warehouse coolers and walk-in-refrigerated~~

warehouse freezers combined in a single enclosure greater than 3,000 square feet (279 m²) in floor area are exempt.

9. ~~Antisweat heaters that are not provided with~~ Where antisweat heaters without anti-sweat heater controls are provided, they shall have a total door rail, glass, and frame heater power draw not ~~greater more~~ than 7.1 W/ft² (76 W/m²) of door opening for ~~walk-in-refrigerated warehouse freezers~~, and not ~~greater more~~ than 3.0 W/ft² (32 W/m²) of door opening for ~~walk-in-refrigerated warehouse coolers~~.
10. ~~Antisweat~~ Where antisweat heater controls are provided, they shall be configured to reduce the energy use of the antisweat heater as a function of the relative humidity in the air outside the door or to the condensation on the inner glass pane.
11. Light sources shall have an efficacy of not less than 40 lumens per Watt, including any ballast losses, or shall be provided with a device that automatically turns off the lights within 15 minutes of when the *walk-in cooler* or *walk-in freezer* was last occupied.

Delete without substitution:

G403.10.2.1 Performance standards (Mandatory). Effective January 1, 2020, ~~walk-in coolers and walk-in freezers~~ shall meet the requirements of Tables G403.10.2.1(1), G403.10.2.1(2) and G403.10.2.1(3).

TABLE G403.10.2.1(1)
WALK-IN COOLER AND FREEZER DISPLAY DOOR EFFICIENCY REQUIREMENTS^a

GLASS DESCRIPTOR	CLASS	MAXIMUM ENERGY CONSUMPTION (kWh/day) ^a
Display door, medium temperature	DD, M	$0.04 \times A_{dd} + 0.41$
Display door, low temperature	DD, L	$0.15 \times A_{dd} + 0.29$

a. ~~A_{dd}~~ is the surface area of the display door.

TABLE G403.10.2.1(2)
WALK-IN COOLER AND FREEZER NONDISPLAY DOOR EFFICIENCY REQUIREMENTS^a

CLASS DESCRIPTOR	CLASS	MAXIMUM ENERGY CONSUMPTION (kWh/day) ^a
Passage door, medium temperature	PD, M	$0.05 \times A_{nd} + 1.7$
Passage door, low temperature	PD, L	$0.14 \times A_{nd} + 4.8$
Freight door, medium temperature	FD, M	$0.04 \times A_{nd} + 1.9$
Freight door, low temperature	FD, L	$0.12 \times A_{nd} + 5.6$

a. ~~A_{nd}~~ is the surface area of the nondisplay door.

TABLE G403.10.2.1(3)
WALK-IN COOLER AND FREEZER REFRIGERATION SYSTEM EFFICIENCY REQUIREMENTS

GLASS DESCRIPTOR	CLASS	MINIMUM ANNUAL WALK-IN ENERGY FACTOR AWEF (Btu/W-h)
Dedicated condensing, medium temperature, indoor system	DC.M.I	5.61

Dedicated condensing, medium temperature, indoor system, > 9,000 Btu/h capacity	DC.M.I, > 9,000	5.61
Dedicated condensing, medium temperature, outdoor system	DC.M.I	7.60
Dedicated condensing, medium temperature, outdoor system, > 9,000 Btu/h capacity	DC.M.I, > 9,000	7.60

Revise as follows:

C403.10.4 Refrigeration systems. Refrigerated display cases, ~~walk-in refrigerated warehouse~~ coolers or ~~walk-in refrigerated warehouse~~ freezers that are served by remote compressors and remote condensers not located in a condensing unit, shall comply with Sections C403.10.4.1 and C403.10.4.2.

Exception: Systems where the working fluid in the refrigeration cycle goes through both subcritical and super-critical states (transcritical) or that use ammonia refrigerant are exempt.

C405.1 General (Mandatory). This section covers lighting system controls, the maximum lighting power for interior and exterior applications and electrical energy consumption.

Dwelling units within multifamily buildings shall comply with Section R404.1. All other dwelling units shall comply with Section R404.1, or with Sections C405.2.4 and C405.3. Sleeping units shall comply with Section C405.2.4, and with Section R404.1 or C405.3. Lighting installed in ~~walk-in coolers, walk-in freezers, refrigerated warehouse coolers and refrigerated warehouse freezers~~ shall comply with the lighting requirements of Section ~~C403.10.1 or C403.10.2. C403.10.1.~~

Reason: The intent of this proposal is to avoid changing requirements, to the extent possible, while maintaining requirements for non-preempted equipment. This proposal coordinates with other proposals attempting to resolve preemption and testing uniformity issues. There are no non-preempted *walk-in coolers* and *walk-in freezers* in the IECC. Coolers and freezers under 3,000ft² fall under 10 CFR Part 431, Subpart R (as defined by 431.302):

"*Walk-in cooler and walk-in freezer* mean an enclosed storage space refrigerated to temperatures, respectively, above, and at or below 32 degrees Fahrenheit that can be walked into, and has a total chilled storage area of **less than 3,000 square feet**; however the terms do not include products designed and marketed exclusively for medical, scientific, or research purposes." (emphasis added)

The IECC definitions (see proposal) limit *walk-in coolers* and *walk-in freezers* to **less than 3,000ft²**, matching the scope of the preemption. Having two sets of requirements - the CFR and the IECC - causes problems, both for building officials and product manufacturers. Having failed in the last cycle to provide an exception for equipment within the scope of the CFR, this proposal removes preempted equipment by removing all "walk-ins," since they are - by definition - preempted. Non-preempted "walk-in" coolers and freezers are defined in the IECC as *refrigerated warehouse coolers* and *refrigerated warehouse freezers*, being 3,000ft² or larger.

Because there still is legal uncertainty regarding the future of the federal preemption requirements, the prescriptive list in (renumbered) C403.10.1 is retained, if only for non-preempted (3,000ft²+) "walk-in" systems. Other proposals update and incorporate newly-effective federal requirements. Where defined *walk-in coolers* and *-freezers* have requirements in other sections, the defined term has been replaced with *refrigerated warehouse coolers* and *-freezers*, as applicable, to provide requirements for non-preempted equipment. The conditions currently regulated for *walk-in coolers* and *walk-in freezers* might not exist in all *refrigerated warehouse coolers* and *refrigerated warehouse freezers*, and would not be applicable in those cases. Additionally, a redundancy between C403.10.1 and C403.10.2 is being addressed by deleting X.1, and attempting to incorporate some clarity improvements to X.2 proposed by SEHPCAC (CE124-16) during the last development cycle.

The desire for language for non-U.S. jurisdictions, where <3,000ft² walk-ins are not preempted, is appreciated, but here causes conflict domestically for the overwhelming majority of code users, officials, and manufacturers

Bibliography: 10 CFR Part 431, Subpart R - Walk-in Coolers and Walk-in Freezers.
10 CFR 431.302 - Definitions concerning walk-in coolers and walk-in freezers.

Cost Impact: The code change proposal will not increase or decrease the cost of construction
The intent of this proposal is to align the code with the current regulatory hierarchy. Equipment already should meet these requirements, so cost should be unaffected or reduced, due to fewer enforcement conflicts.

Proposal # 4904

CE145-19

CE146-19

IECC: C403.10, C403.10.1, TABLE C403.10.1(1), TABLE C403.10.1(2), C403.10.3, Chapter 6CE (New)

Proponent: Amanda Hickman, representing AHRI (amanda@thehickmangroup.com)

2018 International Energy Conservation Code

Revise as follows:

C403.10 Refrigeration equipment performance. Refrigeration equipment shall have an energy use in kWh/day not greater than the values of Tables C403.10.1(1) and C403.10.1(2) when tested and rated in accordance with AHRI Standard 1200. performance shall be determined in accordance with sections C403.10.1 and C403.10.2 for commercial refrigerators, freezers, refrigerator-freezers, walk-in coolers, walk-in freezers and refrigeration equipment. The energy use shall be verified through certification under an approved certification program or, where a certification program does not exist, the energy use shall be supported by data furnished by the equipment manufacturer.

C403.10.1 Walk-in coolers, Commercial refrigerators, walk-in freezers, refrigerated warehouse coolers and refrigerated warehouse freezers refrigerator-freezers and refrigeration (Mandatory). Refrigeration equipment, defined in U.S. 10 CFR part 431.62, shall have an energy use in kWh/day not greater than the values of Table C403.10.1(1) when tested and rated in accordance with AHRI Standard 1200. Refrigerated warehouse coolers and refrigerated warehouse freezers shall comply with this section. Walk-in coolers and walk-in freezers that are neither site-assembled nor site-constructed shall comply with the following:

1. ~~Be equipped with automatic door closers that firmly close walk-in doors that have been closed to within 1 inch (25 mm) of full closure.~~

Exception: Automatic closers are not required for doors more than 45 inches (1143 mm) in width or more than 7 feet (2134 mm) in height.

2. ~~Doorways shall have strip doors, curtains, spring-hinged doors or other method of minimizing infiltration when doors are open.~~
3. ~~Walk-in coolers and refrigerated warehouse coolers shall contain wall, ceiling, and door insulation of not less than R-25 and walk-in freezers and refrigerated warehouse freezers shall contain wall, ceiling and door insulation of not less than R-32.~~

Exception: Glazed portions of doors or structural members need not be insulated.

4. ~~Walk-in freezers shall contain floor insulation of not less than R-28.~~
5. ~~Transparent reach-in doors for walk-in freezers and windows in walk-in freezer doors shall be of triple-pane glass, either filled with inert gas or with heat-reflective treated glass.~~
6. ~~Windows and transparent reach-in doors for walk-in coolers shall be of double-pane or triple-pane, inert gas-filled, heat-reflective treated glass.~~
7. ~~Evaporator fan motors that are less than 1 hp (0.746 kW) and less than 460 volts shall use electronically commutated motors, brushless direct current motors, or 3-phase motors.~~
8. ~~Condenser fan motors that are less than 1 hp (0.746 kW) shall use electronically commutated motors, permanent split capacitor type motors or 3-phase motors.~~
9. ~~Where antisweat heaters without antisweat heater controls are provided, they shall have a total door-rail, glass and frame heater power draw of not more than 7.1 W/ft² (76 W/m²) of door~~

- opening for *walk-in freezers* and 3.0 W/ft^2 (32 W/m^2) of door opening for *walk-in coolers*.
10. ~~Where antisweat heater controls are provided, they shall reduce the energy use of the antisweat heater as a function of the relative humidity in the air outside the door or to the condensation on the inner glass pane.~~
11. ~~Lights in *walk-in coolers*, *walk-in freezers*, *refrigerated warehouse coolers* and *refrigerated warehouse freezers* shall either use light sources with an efficacy of not less than 40 lumens per watt, including ballast losses, or shall use light sources with an efficacy of not less than 40 lumens per watt, including ballast losses, in conjunction with a device that turns off the lights within 15 minutes when the space is not occupied.~~

Delete without substitution:

TABLE C403.10.1(1)
MINIMUM EFFICIENCY REQUIREMENTS: COMMERCIAL REFRIGERATION

EQUIPMENT TYPE	APPLICATION	ENERGY USE LIMITS (kWh per day) ^a	TEST PROCEDURE
Refrigerator with solid doors	Holding Temperature	$0.10 \times V + 2.04$	AHRI 1200
Refrigerator with transparent doors		$0.12 \times V + 3.34$	
Freezers with solid doors		$0.40 \times V + 1.38$	
Freezers with transparent doors		$0.75 \times V + 4.10$	
Refrigerators/freezers with solid doors		the greater of $0.12 \times V + 3.34$ or 0.70	
Commercial refrigerators	Pulldown	$0.126 \times V + 3.51$	

a. V = volume of the chiller or frozen compartment as defined in AHAM HRF-1.

Add new text as follows:

TABLE C403.10.1(1)
MINIMUM EFFICIENCY REQUIREMENTS: COMMERCIAL REFRIGERATORS AND FREEZERS AND REFRIGERATION

Equipment Category	Condensing Unit Configuration	Equipment Family	Rating Temp (F)	Operating Temp (F)	Equipment Classification ^c	Maximum daily energy consumption kWh/day ^{d,e}	Test Standard
		Vertical Open (VOP)	38 (M)	≥ 32	VOP.RC.M	$0.64 \times \text{TDA} + 4.07$	
			0 (L)	< 32	VOP.RC.L	$2.20 \times \text{TDA} + 6.85$	
		Semivertical Open (SVO)	38 (M)	≥ 32	SVO.RC.M	$0.66 \times \text{TDA} + 3.18$	
			0 (L)	< 32	SVO.RC.L	$2.20 \times \text{TDA} + 6.85$	

<u>Remote Condensing Commercial Refrigerators and Commercial Freezers</u>	<u>Remote (RC)</u>	<u>Horizontal Open (HZO)</u>	38 (M)	≥ 32	<u>HZO.RC.M</u>	$0.35 \times \text{TDA} + 2.88$	<u>AHRI 1200</u>
			0 (L)	< 32	<u>HZO.RC.L</u>	$0.55 \times \text{TDA} + 6.88$	
		<u>Vertical Closed Transparent (VCT)</u>	38 (M)	≥ 32	<u>VCT.RC.M</u>	$0.15 \times \text{TDA} + 1.95$	
			0 (L)	< 32	<u>VCT.RC.L</u>	$0.49 \times \text{TDA} + 2.61$	
		<u>Horizontal Closed Transparent (HCT)</u>	38 (M)	≥ 32	<u>HCT.RC.M</u>	$0.16 \times \text{TDA} + 0.13$	
			0 (L)	< 32	<u>HCT.RC.L</u>	$0.34 \times \text{TDA} + 0.26$	
		<u>Vertical Closed Solid (VCS)</u>	38 (M)	≥ 32	<u>VCS.RC.M</u>	$0.10 \times V + 0.26$	
			0 (L)	< 32	<u>VCS.RC.L</u>	$0.21 \times V + 0.54$	
		<u>Horizontal Closed Solid (HCS)</u>	38 (M)	≥ 32	<u>HCS.RC.M</u>	$0.10 \times V + 0.26$	
			0 (L)	< 32	<u>HCS.RC.L</u>	$0.21 \times V + 0.54$	
		<u>Service Over Counter (SOC)</u>	38 (M)	≥ 32	<u>SOC.RC.M</u>	$0.44 \times \text{TDA} + 0.11$	
			0 (L)	< 32	<u>SOC.RC.L</u>	$0.93 \times \text{TDA} + 0.22$	
<u>Self-Contained Commercial Refrigerators and Commercial Freezers with and Without Doors</u>	<u>Self-Contained (SC)</u>	<u>Vertical Open (VOP)</u>	38 (M)	≥ 32	<u>VOP.SCSV.M</u>	$1.69 \times \text{TDA} + 4.71$	<u>AHRI 1200</u>
			0 (L)	< 32	<u>VOP.SC.L</u>	$4.25 \times \text{TDA} + 11.82$	
		<u>Semivertical Open (SVO)</u>	38 (M)	≥ 32	<u>SVO.SC.M</u>	$1.70 \times \text{TDA} + 4.59$	
			0 (L)	< 32	<u>SVO.SC.L</u>	$4.26 \times \text{TDA} + 11.51$	
		<u>Horizontal Open (HZO)</u>	38 (M)	≥ 32	<u>HZO.SC.M</u>	$0.72 \times \text{TDA} + 5.55$	
			0 (L)	< 32	<u>HZO.SC.L</u>	$1.90 \times \text{TDA} + 7.08$	
		<u>Vertical Closed Transparent (VCT)</u>	38 (M)	≥ 32	<u>VCT.SC.M</u>	$0.10 \times V + 0.86$	
			0 (L)	< 32	<u>VCT.SC.L</u>	$0.29 \times V + 2.95$	
		<u>Vertical Closed Solid (VCS)</u>	38 (M)	≥ 32	<u>VCS.SC.M</u>	$0.05 \times V + 1.36$	
			0 (L)	< 32	<u>VCS.SC.L</u>	$0.22 \times V + 1.38$	

		Horizontal Closed Transparent (HCT)	38 (M) 0 (L)	≥ 32 < 32	HCT.SC.M HCT.SC.L	$0.06 \times V + 0.37$ $0.08 \times V + 1.23$	
		Horizontal Closed Solid (HCS)	38 (M) 0 (L)	≥ 32 < 32	HCS.SC.M HCS.SC.L	$0.05 \times V + 0.91$ $0.06 \times V + 1.12$	
		Service Over Counter (SOC)	38 (M) 0 (L)	≥ 32 < 32	SOC.SC.M SOC.SC.L	$0.52 \times TDA + 1.00$ $1.10 \times TDA + 2.10$	
Self-Contained Commercial Refrigerators with Transparent Doors for Pull-Down Temperature Applications	Self-Contained (SC)	Pull-Down (PD)	38 (M)	≥ 32	PD.SC.M	$0.11 \times V + 0.81$	AHRI 1200
Commercial Ice-Cream	Remote (RC)	Vertical Open (VOP)	-15 (I)	$\leq -5^b$	VOP.RC.I	$2.79 \times TDA + 8.70$	AHRI 1200
		Semivertical Open (SVO)	-15 (I)	$\leq -5^b$	SVO.RC.I	$2.79 \times TDA + 8.70$	
		Horizontal Open (HZO)	-15 (I)	$\leq -5^b$	HZO.RC.I	$0.7 \times TDA + 8.74$	
		Vertical Closed Transparent (VCT)	-15 (I)	$\leq -5^b$	VCT.RC.I	$0.58 \times TDA + 3.05$	
		Horizontal Closed Transparent (HCT)	-15 (I)	$\leq -5^b$	HCT.RC.I	$0.4 \times TDA + 0.31$	
		Vertical Closed Solid (VCS)	-15 (I)	$\leq -5^b$	VCS.RC.I	$0.25 \times V + 0.63$	
		Horizontal Closed Solid (HCS)	-15 (I)	$\leq -5^b$	HCS.RC.I	$0.25 \times V + 0.63$	
		Service Over Counter (SOC)	-15 (I)	$\leq -5^b$	SOC.RC.I	$1.09 \times TDA + 0.26$	
	Self-Contained (SC)	Vertical Open (VOP)	-15 (I)	$\leq -5^b$	VOP.SC.I	$5.4 \times TDA + 15.02$	

<u>Freezers</u>	<u>Semivertical</u> <u>Open (SVO)</u>	<u>-15 (I)</u>	<u>≤-5^b</u>	<u>SVO.SC.I</u>	<u>5.41 x TDA</u> <u>+ 14.63</u>	<u>AHRI</u> <u>1200</u>
	<u>Horizontal</u> <u>Open (HZO)</u>	<u>-15 (I)</u>	<u>≤-5^b</u>	<u>HZO.SC.I</u>	<u>2.42 x TDA</u> <u>9.00</u>	
	<u>Vertical</u> <u>Closed</u> <u>Transparent</u> <u>(VCT)</u>	<u>-15 (I)</u>	<u>≤-5^b</u>	<u>VCT.SC.I</u>	<u>0.62 x</u> <u>TDA + 3.29</u>	
	<u>Horizontal</u> <u>Closed</u> <u>Transparent</u> <u>(HCT)</u>	<u>-15 (I)</u>	<u>≤-5^b</u>	<u>HCT.SC.I</u>	<u>0.56 x TDA</u> <u>+ 0.43</u>	
	<u>Vertical</u> <u>Closed Solid</u> <u>(VCS)</u>	<u>-15 (I)</u>	<u>≤-5^b</u>	<u>VCS.SC.I</u>	<u>0.34 x V +</u> <u>0.88.</u>	
	<u>Horizontal</u> <u>Closed Solid</u> <u>(HCS)</u>	<u>-15 (I)</u>	<u>≤-5^b</u>	<u>HCS.SC.I</u>	<u>0.34 x V +</u> <u>0.88.</u>	
	<u>Service</u> <u>Over</u> <u>Counter</u> <u>(SOC)</u>	<u>-15 (I)</u>	<u>≤-5^b</u>	<u>SOC.SC.I</u>	<u>1.53 x TDA</u> <u>+ 0.36</u>	

a. The meaning of the letters in this column is indicated in the columns to the left.

b. Ice-cream freezer is defined in 10 CFR 431.62 as a commercial freezer that is designed to operate at or below –5 °F and that the manufacturer designs, markets, or intends for the storing, displaying, or dispensing of ice cream.

c. Equipment class designations consist of a combination (in sequential order separated by periods (AAA).(BB).(C)) of the following:

(AAA)—An equipment family code (VOP = vertical open, SVO = semivertical open, HZO = horizontal open, VCT = vertical closed transparent doors, VCS = vertical closed solid doors, HCT = horizontal closed transparent doors, HCS = horizontal closed solid doors, and SOC = service over counter); (BB)—An operating mode code (RC = remote condensing and SC = self-contained); and (C)—A rating temperature code (M = medium temperature [38°F], L = low temperature [0°F], or I = ice cream temperature [-15°F]). For example, “VOP.RC.M” refers to the “vertical open, remote condensing, medium temperature” equipment class.

d. V is the volume of the case (ft³) as measured in AHRI Standard 1200, Appendix C.

e. TDA is the total display area of the case (ft²) as measured in AHRI Standard 1200, Appendix D.

Delete without substitution:

TABLE C403.10.1(2)
MINIMUM EFFICIENCY REQUIREMENTS: COMMERCIAL REFRIGERATORS AND FREEZERS

EQUIPMENT TYPE				ENERGY USE LIMITS (kWh/day) ^{a, b}	TEST PROCEDURE
Equipment Class ^c	Family Code	Operating Mode	Rating Temperature		
VOP.RC.M	Vertical open	Remote condensing	Medium	$0.82 \times TDA + 4.07$	AHRI 1200
SVO.RC.M	Semivertical open	Remote condensing	Medium	$0.83 \times TDA + 3.18$	
HZO.RC.M	Horizontal open	Remote condensing	Medium	$0.35 \times TDA + 2.88$	
VOP.RC.L	Vertical open	Remote condensing	Low	$2.27 \times TDA + 6.85$	
HZO.RC.L	Horizontal open	Remote condensing	Low	$0.57 \times TDA + 6.88$	
VCT.RC.M	Vertical transparent door	Remote condensing	Medium	$0.22 \times TDA + 1.95$	
VCT.RC.L	Vertical transparent door	Remote condensing	Low	$0.56 \times TDA + 2.61$	
SOC.RC.M	Service over counter	Remote condensing	Medium	$0.51 \times TDA + 0.11$	
VOP.SC.M	Vertical open	Self-contained	Medium	$1.74 \times TDA + 4.71$	
SVO.SC.M	Semivertical open	Self-contained	Medium	$1.73 \times TDA + 4.59$	
HZO.SC.M	Horizontal open	Self-contained	Medium	$0.77 \times TDA + 5.55$	
HZO.SC.L	Horizontal open	Self-contained	Low	$1.92 \times TDA + 7.08$	
VCT.SC.I	Vertical transparent door	Self-contained	Ice cream	$0.67 \times TDA + 3.29$	
VCS.SC.I	Vertical solid door	Self-contained	Ice cream	$0.38 \times V + 0.88$	
HCT.SC.I	Horizontal transparent door	Self-contained	Ice cream	$0.56 \times TDA + 0.43$	
SVO.RC.L	Semivertical open	Remote condensing	Low	$2.27 \times TDA + 6.85$	
VOP.RC.I	Vertical open	Remote condensing	Ice cream	$2.89 \times TDA + 8.7$	
SVO.RC.I	Semivertical open	Remote condensing	Ice cream	$2.89 \times TDA + 8.7$	
HZO.RC.I	Horizontal open	Remote condensing	Ice cream	$0.72 \times TDA + 8.74$	
VCT.RC.I	Vertical transparent door	Remote condensing	Ice cream	$0.66 \times TDA + 3.05$	
HCT.RC.M	Horizontal transparent door	Remote condensing	Medium	$0.16 \times TDA + 0.13$	

HCT.RC.L	Horizontal transparent door	Remote condensing	Low	$0.34 \times TDA + 0.26$
HCT.RC.I	Horizontal transparent door	Remote condensing	Ice cream	$0.4 \times TDA + 0.31$
VCS.RC.M	Vertical solid door	Remote condensing	Medium	$0.11 \times V + 0.26$
VCS.RC.L	Vertical solid door	Remote condensing	Low	$0.23 \times V + 0.54$
VCS.RC.I	Vertical solid door	Remote condensing	Ice cream	$0.27 \times V + 0.63$
HCS.RC.M	Horizontal solid door	Remote condensing	Medium	$0.11 \times V + 0.26$
HCS.RC.L	Horizontal solid door	Remote condensing	Low	$0.23 \times V + 0.54$
HCS.RC.I	Horizontal solid door	Remote condensing	Ice cream	$0.27 \times V + 0.63$
HCS.RC.I	Horizontal solid door	Remote condensing	Ice cream	$0.27 \times V + 0.63$
SOC.RC.L	Service over counter	Remote condensing	Low	$1.08 \times TDA + 0.22$
SOC.RC.I	Service over counter	Remote condensing	Ice cream	$1.26 \times TDA + 0.26$
VOP.SC.L	Vertical open	Self-contained	Low	$4.37 \times TDA + 11.82$
VOP.SC.I	Vertical open	Self-contained	Ice cream	$5.55 \times TDA + 15.02$
SVO.SC.L	Semivertical open	Self-contained	Low	$4.34 \times TDA + 11.51$
SVO.SC.I	Semivertical open	Self-contained	Ice cream	$5.52 \times TDA + 14.63$
HZO.SC.I	Horizontal open	Self-contained	Ice cream	$2.44 \times TDA + 9.0$
SOC.SC.I	Service over counter	Self-contained	Ice cream	$1.76 \times TDA + 0.36$
HCS.SC.I	Horizontal solid door	Self-contained	Ice cream	$0.38 \times V + 0.88$

- a. V = Volume of the case, as measured in accordance with Appendix C of AHRI 1200.
- b. TDA = Total display area of the case, as measured in accordance with Appendix D of AHRI 1200.
- e. Equipment class designations consist of a combination [in sequential order separated by periods (AAA).(BB).(C)] of:

(AAA)	An equipment family code where:		
	VOP	=	vertical open
	SVO	=	semivertical open
	HZO	=	horizontal open
	HCT	=	horizontal transparent doors
	HCS	=	horizontal solid doors
	SOC	=	service over counter
(BB)	An operating mode code:		

	RC	=	remote condensing
	SC	=	self-contained
(C)	A rating temperature code:		
	M	=	medium temperature (38°F)
	L	=	low temperature (0°F)
	I	=	ice-cream temperature (15°F)

For example, “VOP.RC.M” refers to the “vertical-open, remote-condensing, medium-temperature” equipment class.

~~C403.10.3 Refrigerated display cases (Mandatory).~~ Site-assembled or site-constructed refrigerated display cases shall comply with the following:

- ~~1. Lighting and glass doors in refrigerated display cases shall be controlled by one of the following:~~
 - ~~1.1. Time-switch controls to turn off lights during nonbusiness hours. Timed overrides for display cases shall turn the lights on for up to 1 hour and shall automatically time out to turn the lights off.~~
 - ~~1.2. Motion-sensor controls on each display case section that reduce lighting power by not less than 50 percent within 3 minutes after the area within the sensor range is vacated.~~
- ~~2. Low-temperature display cases shall incorporate temperature-based defrost termination control with a time-limit default. The defrost cycle shall terminate first on an upper temperature limit breach and second upon a time limit breach.~~
- ~~3. Antisweat heater controls shall reduce the energy use of the antisweat heater as a function of the relative humidity in the air outside the door or to the condensation on the inner glass pane.~~

Add new text as follows:

DOE

U.S. Department of Energy
c/o Superintendent of Documents
1000 Independence Avenue SW
Washington DC 20585

U.S. 10 Part CFR 431, Subpart R: Commercial Refrigerators, Freezers and Refrigerator-Freezers

AHRI

Air-Conditioning, Heating, &
Refrigeration Institute
2111 Wilson Blvd, Suite 500
Arlington VA 22201

AHRI 1250-(I-P) 2014:

Standard for Performance Rating in Walk-in Coolers and Freezers

Reason: This proposal removes the conflict with current federal regulations and updates this section by replacing the outdated prescriptive language to be consistent with current DOE regulations. It also combines the current tables into one, which harmonizes with the federal regulations and recent updates made to ASHRAE 90.1.

Bibliography: 1. ENERGY INDEPENDENCE AND SECURITY ACT OF 2007, Section 312, Walk-in Coolers and

Walk-in Freezers.

2. Code of Federal Regulations, US 10 CFR 431.306

3. 2014-06-03 Energy Conservation Program: Energy Conservation Standards for Walk-In Coolers and Freezers; Final Rule

[https://www.ecfr.gov/cgi-bin/retrieveECFR?](https://www.ecfr.gov/cgi-bin/retrieveECFR?gp=&SID=396fdb135febfc51995dca67c2cee17&mc=true&n=pt10.3.431&r=P ART&ty=HTML#sp10.3.431.c)

[gp=&SID=396fdb135febfc51995dca67c2cee17&mc=true&n=pt10.3.431&r=P ART&ty=HTML#sp10.3.431.c](https://www.ecfr.gov/cgi-bin/retrieveECFR?gp=&SID=396fdb135febfc51995dca67c2cee17&mc=true&n=pt10.3.431&r=P ART&ty=HTML#sp10.3.431.c)

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

This proposal updates the requirements to the current federal mandate, clarifying that there are no additional requirements that need to be satisfied. Deleting the additional requirements will drastically reduce the cost to the consumer, and thereby reducing the cost of construction.

Proposal # 5379

CE146-19

CE147-19

IECC: C402.1, C403.10.1, C403.10.2, C403.10.2.1, TABLE C403.10.2.1(1), TABLE C403.10.2.1(2), TABLE C403.10.2.1(3)

Proponent: Thomas D. Culp, Ph.D., Birch Point Consulting LLC, representing self
(culp@birchpointconsulting.com)

2018 International Energy Conservation Code

Revise as follows:

C402.1 General (Prescriptive). Building thermal envelope assemblies for buildings that are intended to comply with the code on a prescriptive basis in accordance with the compliance path described in Item 2 of Section C401.2, shall comply with the following:

1. The opaque portions of the building thermal envelope shall comply with the specific insulation requirements of Section C402.2 and the thermal requirements of either the *R*-value-based method of Section C402.1.3; the *U*-, *C*- and *F*-factor-based method of Section C402.1.4; or the component performance alternative of Section C402.1.5.
2. Roof solar reflectance and thermal emittance shall comply with Section C402.3.
3. Fenestration in building envelope assemblies shall comply with Section C402.4.
4. Air leakage of building envelope assemblies shall comply with Section C402.5.

Alternatively, where buildings have a vertical fenestration area or skylight area exceeding that allowed in Section C402.4, the building and building thermal envelope shall comply with Section C401.2, Item 1 or Section C401.2, Item 3.

Walk-in coolers, walk-in freezers, refrigerated warehouse coolers and refrigerated warehouse freezers shall comply with Section C403.10.1 ~~or C403.10.2~~.

C403.10.1 Walk-in coolers, walk-in freezers, refrigerated warehouse coolers and refrigerated warehouse freezers (Mandatory). ~~Refrigerated warehouse coolers and refrigerated warehouse freezers shall comply with this section. Walk-in coolers and walk-in freezers that are neither site assembled nor site constructed shall comply with the following:~~

~~1. Be equipped with automatic door closers that firmly close walk-in doors that have been closed to within 1 inch (25 mm) of full closure.~~

Exception: Automatic closers are not required for doors more than 45 inches (1143 mm) in width or more than 7 feet (2134 mm) in height.

~~2. Doorways shall have strip doors, curtains, spring-hinged doors or other method of minimizing infiltration when doors are open.~~

~~3. Walk-in coolers and refrigerated warehouse coolers shall contain wall, ceiling, and door insulation of not less than R-25 and walk-in freezers and refrigerated warehouse freezers shall contain wall, ceiling and door insulation of not less than R-32.~~

Exception: Glazed portions of doors or structural members need not be insulated.

~~4. Walk-in freezers shall contain floor insulation of not less than R-28.~~

~~5. Transparent reach-in doors for walk-in freezers and windows in walk-in freezer doors shall be of triple-pane glass, either filled with inert gas or with heat-reflective treated glass.~~

~~6. Windows and transparent reach-in doors for walk-in coolers shall be of double-pane or triple-~~

pane, inert gas-filled, heat-reflective treated glass-

7. ~~Evaporator fan motors that are less than 1 hp (0.746 kW) and less than 460 volts shall use electronically commutated motors, brushless direct current motors, or 3-phase motors.~~

8. ~~Condenser fan motors that are less than 1 hp (0.746 kW) shall use electronically commutated motors, permanent split capacitor-type motors or 3-phase motors.~~

9. ~~Where antisweat heaters without antisweat heater controls are provided, they shall have a total door rail, glass and frame heater power draw of not more than 7.1 W/ft² (76 W/m²) of door opening for walk-in freezers and 3.0 W/ft² (32 W/m²) of door opening for walk-in coolers.~~

10. ~~Where antisweat heater controls are provided, they shall reduce the energy use of the antisweat heater as a function of the relative humidity in the air outside the door or to the condensation on the inner glass pane.~~

11. ~~Lights in walk-in coolers, walk-in freezers, refrigerated warehouse coolers and refrigerated warehouse freezers shall either use light sources with an efficacy of not less than 40 lumens per watt, including ballast losses, or shall use light sources with an efficacy of not less than 40 lumens per watt, including ballast losses, in conjunction with a device that turns off the lights within 15 minutes when the space is not occupied.~~

G403.10.2 Walk-in coolers and walk-in freezers (Mandatory). ~~Site-assembled or site-constructed Refrigerated warehouse coolers, refrigerated warehouse freezers, walk-in coolers, and walk-in freezers shall comply with the following:~~

1. Automatic door closers shall be provided that fully close walk-in doors that have been closed to within 1 inch (25 mm) of full closure.

Exception: Closers are not required for doors more than 45 inches (1143 mm) in width or more than 7 feet (2134 mm) in height.

2. Doorways shall be provided with strip doors, curtains, spring-hinged doors or other method of minimizing infiltration when the doors are open.
3. Walls shall be provided with insulation having a thermal resistance of not less than R-25, ceilings shall be provided with insulation having a thermal resistance of not less than R-25 and doors of walk-in coolers and walk-in freezers shall be provided with insulation having a thermal resistance of not less than R-32.

Exception: Insulation is not required for glazed portions of doors or at structural members associated with the walls, ceiling or door frame.

4. The floor of walk-in freezers shall be provided with insulation having a thermal resistance of not less than R-28.
5. Transparent reach-in doors for and windows in opaque walk-in freezer doors shall be provided with triple-pane glass having the interstitial spaces filled with inert gas or provided with heat-reflective treated glass, glass, or vacuum insulating glazing.
6. Transparent reach-in doors for and windows in opaque walk-in cooler doors shall be double-pane heat-reflective treated glass having the interstitial space gas filled, filled, or vacuum insulating glazing.
7. Evaporator fan motors that are less than 1 hp (0.746 kW) and less than 460 volts shall be electronically commutated motors or 3-phase motors.
8. Condenser fan motors that are less than 1 hp (0.746 kW) in capacity shall be of the electronically commutated or permanent split capacitor-type or shall be 3-phase motors.

Exception: Fan motors in walk-in coolers and walk-in freezers combined in a single enclosure greater than 3,000 square feet (279 m²) in floor area are exempt.

9. Antisweat heaters that are not provided with anti-sweat heater controls shall have a total door rail, glass and frame heater power draw not greater than 7.1 W/ft² (76 W/m²) of door opening for walk-in freezers, and not greater than 3.0 W/ft² (32 W/m²) of door opening for walk-in coolers.

10. Antisweat heater controls shall be configured to reduce the energy use of the antisweat heater as a function of the relative humidity in the air outside the door or to the condensation on the inner glass pane.
11. Light sources shall have an efficacy of not less than 40 lumens per Watt, including any ballast losses, or shall be provided with a device that automatically turns off the lights within 15 minutes of when the *walk-in cooler* or *walk-in freezer* was last occupied.

~~C403.10.2.1 Performance standards (Mandatory).~~ ~~Effective January 1, 2020,~~
~~Doors in walk-in coolers and walk-in freezers shall meet the requirements of Tables C403.10.2.1 C403.10.1(1) ,~~
~~C403.10.2.1 and C403.10.1(2) and C403.10.2.1 .~~

Walk-in cooler and walk-in freezer refrigeration systems, except for walk-in process cooling refrigeration systems as defined in U.S. 10 CFR 431.302, shall meet the requirements of Table C403.10.1(3).

TABLE ~~C403.10.2.1~~ C403.10.1(1)
WALK-IN COOLER AND FREEZER DISPLAY DOOR EFFICIENCY REQUIREMENTS^a

CLASS DESCRIPTOR	CLASS	MAXIMUM ENERGY CONSUMPTION (kWh/day) ^a
Display door, medium temperature	DD, M	$0.04 \times A_{dd} + 0.41$
Display door, low temperature	DD, L	$0.15 \times A_{dd} + 0.29$

- a. A_{dd} is the surface area of the display door.

TABLE ~~C403.10.2.1~~ C403.10.1(2)
WALK-IN COOLER AND FREEZER NONDISPLAY DOOR EFFICIENCY REQUIREMENTS^a

CLASS DESCRIPTOR	CLASS	MAXIMUM ENERGY CONSUMPTION (kWh/day) ^a
Passage door, medium temperature	PD, M	$0.05 \times A_{nd} + 1.7$
Passage door, low temperature	PD, L	$0.14 \times A_{nd} + 4.8$
Freight door, medium temperature	FD, M	$0.04 \times A_{nd} + 1.9$
Freight door, low temperature	FD, L	$0.12 \times A_{nd} + 5.6$

- a. A_{nd} is the surface area of the nondisplay door.

TABLE ~~C403.10.2.1~~ C403.10.1(3)
WALK-IN COOLER AND FREEZER REFRIGERATION SYSTEM EFFICIENCY REQUIREMENTS

CLASS DESCRIPTOR	CLASS	MINIMUM ANNUAL WALK-IN ENERGY FACTOR AWEF (Btu/W-h) ^a
Dedicated condensing, medium temperature, indoor system	DC.M.I	5.61
Dedicated condensing, medium temperature, indoor system, > 9,000 Btu/h capacity	DC.M.I, > 9,000	5.61
Dedicated condensing, medium temperature, outdoor system	DC.M.I.O	7.60
Dedicated condensing, medium temperature, outdoor system, > 9,000 Btu/h capacity	DC.M.I, > 9,000	7.60

Dedicated condensing, low temperature, indoor system, net capacity (q_{net}) < 6,500 Btu/h	DC.L.I., < 6,500	$9.091 \times 10^{-5} \times q_{net} + 1.81$
Dedicated condensing, low temperature, indoor system, net capacity (q_{net}) \geq 6,500 Btu/h	DC.L.I., \geq 6,500	2.40
Dedicated condensing, low temperature, outdoor system, net capacity (q_{net}) < 6,500 Btu/h	DC.L.O., < 6,500	$6.522 \times 10^{-5} \times q_{net} + 2.73$
Dedicated condensing, low temperature, outdoor system, net capacity (q_{net}) \geq 6,500 Btu/h	DC.L.O., \geq 6,500	3.15
Unit cooler, medium	UC.M	9.00
Unit cooler, low temperature, net capacity (q_{net}) < 15,500 Btu/h	UC.L., < 15,500	$1.575 \times 10^{-5} \times q_{net} + 3.91$
Unit cooler, low temperature, net capacity (q_{net}) \geq 15,500 Btu/h	UC.L., \geq 15,500	4.15

a. q_{net} is net capacity as determined in accordance with 10 CFR 431.304 and certified in accordance with 10 CFR part 429.

Reason: The purpose of this proposal is to clean up outdated language regarding walk-in cooler and walk-in freezer requirements, and make the requirements consistent with current federal regulations that either already came into effect June 5, 2017 or will come into effect July 10, 2020 prior to implementation of the 2021 IECC. Most importantly, the performance requirements for walk-in coolers and freezer in Tables C403.10.2.1(1) through (3) are updated to be consistent with 10 CFR 431.306. Additionally, the redundant itemized lists in Sections C403.10.1 and C403.10.2 are combined into one section. There is no reason to repeat the same requirements twice that apply to both site-built and prefabricated walk-in coolers and freezers (defined as < 3,000 ft²) and refrigerated warehouse coolers and freezers (>3,000 ft²). Finally, vacuum insulating glazing is added to the list of allowed glazing options in reach-in doors, as the current wording could inadvertently be misinterpreted as not including vacuum insulating glazing. The thermal resistance of vacuum insulating glazing is at least twice that of other options (e.g. R10 for vacuum insulating glazing vs. R3-5 for the other options), so this ensures there is no unintended barrier to using these higher performance products.

Links to the federal standards are as follows:

10 CFR 431.302 - Definitions concerning walk-in coolers and walk-in freezers. <https://www.law.cornell.edu/cfr/text/10/431.302>

10 CFR 431.304 - Uniform test method for the measurement of energy consumption of walk-in coolers and walk-in freezers. <https://www.law.cornell.edu/cfr/text/10/431.304>

10 CFR Part 429 - Certification, compliance, and enforcement for consumer products and commercial and industrial equipment. <https://www.law.cornell.edu/cfr/text/10/part-429>

Cost Impact: The code change proposal will increase the cost of construction. Increased product costs associated with the increased performance requirements were evaluated as part of the federal rulemaking process and deemed cost effective. For instance, see

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IECC: C403.10.1, C403.10.2

Proponent: Thomas D. Culp, Ph.D., Birch Point Consulting LLC, representing the Glazing Industry Code Committee (culp@birchpointconsulting.com)

2018 International Energy Conservation Code

Revise as follows:

C403.10.1 Walk-in coolers, walk-in freezers, refrigerated warehouse coolers and refrigerated warehouse freezers (Mandatory). *Refrigerated warehouse coolers and refrigerated warehouse freezers* shall comply with this section. *Walk-in coolers and walk-in freezers* that are neither site assembled nor site constructed shall comply with the following:

1. Be equipped with automatic door-closers that firmly close walk-in doors that have been closed to within 1 inch (25 mm) of full closure.
Exception: Automatic closers are not required for doors more than 45 inches (1143 mm) in width or more than 7 feet (2134 mm) in height.
2. Doorways shall have strip doors, curtains, spring-hinged doors or other method of minimizing infiltration when doors are open.
3. *Walk-in coolers and refrigerated warehouse coolers* shall contain wall, ceiling, and door insulation of not less than R-25 and *walk-in freezers and refrigerated warehouse freezers* shall contain wall, ceiling and door insulation of not less than R-32.
Exception: Glazed portions of doors or structural members need not be insulated.
4. *Walk-in freezers* shall contain floor insulation of not less than R-28.
5. Transparent reach-in doors for *walk-in freezers* and windows in *walk-in freezer* doors shall be of triple-pane glass, either filled with inert gas or with heat-reflective treated glass, or vacuum insulating glazing.
6. Windows and transparent reach-in doors for *walk-in coolers* shall be of double-pane or triple-pane, inert gas-filled, heat-reflective treated glass, or vacuum insulating glazing.
7. Evaporator fan motors that are less than 1 hp (0.746 kW) and less than 460 volts shall use electronically commutated motors, brushless direct-current motors, or 3-phase motors.
8. Condenser fan motors that are less than 1 hp (0.746 kW) shall use electronically commutated motors, permanent split capacitor-type motors or 3-phase motors.
9. Where antisweat heaters without antisweat heater controls are provided, they shall have a total door rail, glass and frame heater power draw of not more than 7.1 W/ft² (76 W/m²) of door opening for *walk-in freezers* and 3.0 W/ft² (32 W/m²) of door opening for *walk-in coolers*.
10. Where antisweat heater controls are provided, they shall reduce the energy use of the antisweat heater as a function of the relative humidity in the air outside the door or to the condensation on the inner glass pane.
11. Lights in *walk-in coolers, walk-in freezers, refrigerated warehouse coolers and refrigerated warehouse freezers* shall either use light sources with an efficacy of not less than 40 lumens per watt, including ballast losses, or shall use light sources with an efficacy of not less than 40 lumens per watt, including ballast losses, in conjunction with a device that turns off the lights within 15 minutes when the space is not occupied.

C403.10.2 Walk-in coolers and walk-in freezers (Mandatory). Site-assembled or site-constructed *walk-in coolers and walk-in freezers* shall comply with the following:

1. Automatic door closers shall be provided that fully close walk-in doors that have been closed to within 1 inch (25 mm) of full closure.
Exception: Closers are not required for doors more than 45 inches (1143 mm) in width or more than 7 feet (2134 mm) in height.
2. Doorways shall be provided with strip doors, curtains, spring-hinged doors or other method of minimizing infiltration when the doors are open.
3. Walls shall be provided with insulation having a thermal resistance of not less than R-25, ceilings shall be provided with insulation having a thermal resistance of not less than R-25 and doors of *walk-in coolers* and *walk-in freezers* shall be provided with insulation having a thermal resistance of not less than R-32.
Exception: Insulation is not required for glazed portions of doors or at structural members associated with the walls, ceiling or door frame.
4. The floor of *walk-in freezers* shall be provided with insulation having a thermal resistance of not less than R-28.
5. Transparent reach-in doors for and windows in opaque *walk-in freezer* doors shall be provided with triple-pane glass having the interstitial spaces filled with inert gas or provided with heat-reflective treated glass, or vacuum insulating glazing.
6. Transparent reach-in doors for and windows in opaque *walk-in cooler* doors shall be double-pane heat-reflective treated glass having the interstitial space gas filled, or vacuum insulating glazing.
7. Evaporator fan motors that are less than 1 hp (0.746 kW) and less than 460 volts shall be electronically commutated motors or 3-phase motors.
8. Condenser fan motors that are less than 1 hp (0.746 kW) in capacity shall be of the electronically commutated or permanent split capacitor-type or shall be 3-phase motors.
Exception: Fan motors in *walk-in coolers* and *walk-in freezers* combined in a single enclosure greater than 3,000 square feet (279 m²) in floor area are exempt.
9. Antisweat heaters that are not provided with anti-sweat heater controls shall have a total door rail, glass and frame heater power draw not greater than 7.1 W/ft² (76 W/m²) of door opening for *walk-in freezers*, and not greater than 3.0 W/ft² (32 W/m²) of door opening for *walk-in coolers*.
10. Antisweat heater controls shall be configured to reduce the energy use of the antisweat heater as a function of the relative humidity in the air outside the door or to the condensation on the inner glass pane.
11. Light sources shall have an efficacy of not less than 40 lumens per Watt, including any ballast losses, or shall be provided with a device that automatically turns off the lights within 15 minutes of when the *walk-in cooler* or *walk-in freezer* was last occupied.

Reason: The purpose of this proposal is to ensure the code does not prohibit the use of new vacuum insulating glazing products in reach-in doors for walk-in coolers and freezers. These high performance products have been recently commercialized by multiple manufacturers and are already being used in display doors for walk-in coolers, walk-in freezers, and stand-alone refrigerated display cases. However, items 5 and 6 of Sections C403.10.1 and C403.10.2 have specific limited options for reach-in doors: double pane glazing with argon and low-e glass for coolers, and triple pane glass with either argon or low-e glass for freezers. This is overly prescriptive and could be interpreted as not including vacuum insulating glazing, and introduces a barrier to these higher performance products. The thermal resistance of vacuum insulating glazing is at least twice that of other options (e.g. R10 for vacuum insulating glazing vs. R3-5 for the other options). Therefore, this proposal adds vacuum insulating glazing to the list of options for reach-in doors. These changes are necessary as it is important that an energy code not actually hinder the use of innovative, higher performance products. Note: a separate proposal includes a comprehensive update to the entire walk-in cooler and freezer section, updating the performance requirement tables. However, this simple proposal at least addresses the specific

problem for vacuum insulating glazing, in case the code development body does not approve the broader proposal.

Cost Impact: The code change proposal will not increase or decrease the cost of construction. While vacuum insulating glazing is more expensive than traditional glazing options for display doors, this is not a requirement to use vacuum insulating glazing. This proposal simply removes a barrier so that vacuum insulating glazing may be considered as an option.

Proposal # 4902

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CE149-19

IECC: C403.10.2, TABLE C403.10.2.1(1), TABLE C403.10.2.1(2), TABLE C403.10.2.1(3), DOE Chapter 06 (New), AHRI Chapter 06 (New)

Proponent: IECC: C403.10.2, TABLE C403.10.2.1(1), TABLE C403.10.2.1(2), TABLE C403.10.2.1(3), Chapter 6CE (New)

2018 International Energy Conservation Code

Revise as follows:

C403.10.2 Walk-in coolers and walk-in freezers (Mandatory). Walk-in cooler and walk-in freezer refrigeration systems, except for walk-in process cooling refrigeration systems as defined in U.S. 10 CFR 431.302, shall meet the requirements of Tables C403.10.2(1), C403.10.2(2), and C403.10.2(3). ~~Site-assembled or site-constructed walk-in coolers and walk-in freezers shall comply with the following:~~

1. Automatic door closers shall be provided that fully close walk-in doors that have been closed to within 1 inch (25 mm) of full closure.

Exception: Closers are not required for doors more than 45 inches (1143 mm) in width or more than 7 feet (2134 mm) in height.

2. ~~Doorways shall be provided with strip doors, curtains, spring-hinged doors or other method of minimizing infiltration when the doors are open.~~
3. ~~Walls shall be provided with insulation having a thermal resistance of not less than R-25, ceilings shall be provided with insulation having a thermal resistance of not less than R-25 and doors of walk-in coolers and walk-in freezers shall be provided with insulation having a thermal resistance of not less than R-32.~~

Exception: Insulation is not required for glazed portions of doors or at structural members associated with the walls, ceiling or door frame.

4. ~~The floor of walk-in freezers shall be provided with insulation having a thermal resistance of not less than R-28.~~
5. ~~Transparent reach-in doors for and windows in opaque walk-in freezer doors shall be provided with triple-pane glass having the interstitial spaces filled with inert gas or provided with heat-reflective treated glass.~~
6. ~~Transparent reach-in doors for and windows in opaque walk-in cooler doors shall be double-pane heat reflective treated glass having the interstitial space gas filled.~~
7. ~~Evaporator fan motors that are less than 1 hp (0.746 kW) and less than 460 volts shall be electronically commutated motors or 3-phase motors.~~
8. ~~Condenser fan motors that are less than 1 hp (0.746 kW) in capacity shall be of the electronically commutated or permanent split capacitor type or shall be 3-phase motors.~~

Exception: Fan motors in walk-in coolers and walk-in freezers combined in a single enclosure greater than 3,000 square feet (279 m²) in floor area are exempt.

9. ~~Antisweat heaters that are not provided with anti-sweat heater controls shall have a total door rail, glass and frame heater power draw not greater than 7.1 W/ft² (76 W/m²) of door opening for walk-in freezers, and not greater than 3.0 W/ft² (32 W/m²) of door opening for walk-in coolers.~~

10. ~~Antisweat heater controls shall be configured to reduce the energy use of the antisweat heater as a function of the relative humidity in the air outside the door or to the condensation on the inner glass pane.~~
11. ~~Light sources shall have an efficacy of not less than 40 lumens per Watt, including any ballast losses, or shall be provided with a device that automatically turns off the lights within 15 minutes of when the walk-in cooler or walk-in freezer was last occupied.~~

TABLE ~~G403.10.2.1~~ C403.10.2(1)
WALK-IN COOLER AND FREEZER DISPLAY DOOR EFFICIENCY REQUIREMENTS^a

CLASS DESCRIPTOR	CLASS	MAXIMUM ENERGY CONSUMPTION (kWh/day) ^a
Display door, medium temperature	DD, M	$0.04 \times A_{dd} + 0.41$
Display door, low temperature	DD, L	$0.15 \times A_{dd} + 0.29$

- a. A_{dd} is the surface area of the display door.

TABLE ~~G403.10.2.1~~ C403.10.2(2)
WALK-IN COOLER AND FREEZER NONDISPLAY DOOR EFFICIENCY REQUIREMENTS^a

CLASS DESCRIPTOR	CLASS	MAXIMUM ENERGY CONSUMPTION (kWh/day) ^a
Passage door, medium temperature	PD, M	$0.05 \times A_{nd} + 1.7$
Passage door, low temperature	PD, L	$0.14 \times A_{nd} + 4.8$
Freight door, medium temperature	FD, M	$0.04 \times A_{nd} + 1.9$
Freight door, low temperature	FD, L	$0.12 \times A_{nd} + 5.6$

- a. A_{nd} is the surface area of the nondisplay door.

TABLE ~~G403.10.2.1~~ C403.10.2(3)
WALK-IN COOLER AND FREEZER REFRIGERATION SYSTEM EFFICIENCY REQUIREMENTS

CLASS DESCRIPTOR	CLASS	MINIMUM ANNUAL WALK-IN ENERGY FACTOR AWEF (Btu/W-h) ^a	Test Procedure
Dedicated condensing, medium temperature, indoor system	DC.M.I	5.61	AHRI 1250
Dedicated condensing, medium temperature, indoor system, > 9,000 Btu/h capacity	DC.M.I, > 9,000	5.61	
Dedicated condensing, medium temperature, outdoor system	DC.M.O	7.60	
Dedicated condensing, medium temperature, outdoor system, > 9,000 Btu/h capacity	DC.M.O, > 9,000	7.60	
Dedicated condensing, low temperature, indoor system, net capacity (q_{net}) < 6,500 Btu/h	DC.L.I, < 6,500	$9.091 \times 10^{-5} \times q_{net} + 1.81$	
Dedicated condensing, low temperature, indoor system, net capacity (q_{net}) ≥ 6,500 Btu/h	DC.L.I, ≥ 6,500	2.40	

Dedicated condensing, low temperature, outdoor system, net capacity (q_{net}) < 6,500 Btu/h	DC.L.O., < 6,500	$6.522 \times 10^{-5} \times q_{net} + 2.73$
Dedicated condensing, low temperature, outdoor system, net capacity (q_{net}) ≥ 6,500 Btu/h	DC.L.O., ≥ 6,500	3.15
Unit cooler, medium	UC.M	9.00
Unit cooler, low temperature, net capacity (q_{net}) < 15,500 Btu/h	UC.L., < 15,500	$1.575 \times 10^{-5} \times q_{net} + 3.91$
Unit cooler, low temperature, net capacity (q_{net}) ≥ 15,500 Btu/h	UC.L., ≥ 15,500	4.15

a. q_{net} is net capacity (Btu/hr) as determined in accordance with AHRI Standard 1250

Add new standard(s) as follows:

DOE

U.S. Department of Energy
c/o Superintendent of Documents
1000 Independence Avenue SW
Washington DC 20585

U.S. 10 Part CFR 431, Subpart R: Walk-in Coolers and Walk-in Freezers

AHRI

Air-Conditioning, Heating, &
Refrigeration Institute
2111 Wilson Blvd, Suite 500
Arlington VA 22201

AHRI 1250-(I-P) 2014: Standard for Performance Rating in Walk-in Coolers and Freezers

Reason: This proposal is intended to update language regarding walk-in cooler and walk-in freezer requirements to be consistent with current federal regulations that are already in effect as well as with those that will become effective in 2020, prior to the publishing of this code. This will also harmonize the IECC with recent updates made to ASHRAE 90.1.

This proposal reorganizes and cleans up language by deleting the prescriptive requirements and updates the tables that are out of sync with U.S.10 CFR 431. This will streamline the requirements thereby reducing confusion for code officials.

Bibliography: 1. ENERGY INDEPENDENCE AND SECURITY ACT OF 2007, Section 312, Walk-in Coolers and Walkin Freezers.

2. Code of Federal Regulations, US 10 CFR 431.306

3. 2014-06-03 Energy Conservation Program: Energy Conservation Standards for Walk-In Coolers and Freezers; Final Rule

[https://www.ecfr.gov/cgi-bin/retrieveECFR?](https://www.ecfr.gov/cgi-bin/retrieveECFR?gp=&SID=396fdbcf135febfc51995dca67c2cee17&mc=true&n=pt10.3.431&r=P ART&ty=HTML#sp10.3.431.c)

[gp=&SID=396fdbcf135febfc51995dca67c2cee17&mc=true&n=pt10.3.431&r=P ART&ty=HTML#sp10.3.431.c](https://www.ecfr.gov/cgi-bin/retrieveECFR?gp=&SID=396fdbcf135febfc51995dca67c2cee17&mc=true&n=pt10.3.431&r=P ART&ty=HTML#sp10.3.431.c)

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

This proposal updates the requirements to the current federal mandate, clarifying that there are no additional requirements that need to be satisfied. Deleting the additional requirements will drastically reduce the cost to the consumer, and thereby reducing the cost of construction.

Staff Analysis: A review of the standard proposed for inclusion in the code, AHRI 1250-(I-P) 2014, 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.

Proposal # 5402

CE149-19

CE150-19 Part I

PART I — IECC: C403.11.3.1

PART II — IECC: R403.4.1 (IRC N1103.4.1)

Proponent: Howard Ahern, representing self (howard.ahern@airexmfg.com)

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

2018 International Energy Conservation Code

Revise as follows:

C403.11.3.1 Protection of piping insulation (Mandatory). Piping insulation exposed to the weather shall be protected from damage, including that caused by sunlight, moisture, wind, and physical damage. Protective barrier shall be removable for equipment maintenance and wind, and shall provide shielding from solar radiation that can cause degradation of the material. Adhesive tape shall not be permitted.

Proposal # 4565

CE150-19 Part I

CE150-19 Part II

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. Piping insulation exposed to weather shall be protected from damage, including that caused by sunlight, moisture, wind and physical damage. Protective barrier shall be removeable for 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: This proposal will clarify the intent of section R403.4.1 The intent of this section is not only protection of pipe insulation from weather but to insure the insulations thermal conductivity energy savings integrity last the life of the mechanical system as per the intent of the code . In order to remove the opportunity for misunderstanding so that the code has its's intended result the term "equipment maintenance" must be clarified. The intent is in the original proponents reason statement of this requirement EC110-09/10 stated -" All AC units require periodic maintenance. The frequency varies with how hard the unit operates, exterior temperature, preventive maintenance program, and many others. In every occasion, every maintenance provides an excuse for the Freon line insulation to be touched and removed." The intent is clear that the protection be removable and independent of the pipe insulation for maintenance without damaging the pipe insulation.

Removing protection without damaging the insulation is stated in EC110-09/10 "Adhesives Tape is not permitted as it will limit maintenance and damage insulations permeability characteristics. Removal of tape damages the integrity of the original insulation into pieces, specially, if the insulation has reached thermo set state."

Protective covering must also protect from physical damage so if the protection covering does get damaged from stepping on it, dropping tools on it, birds, lawn trimmers etc.it can be replaced keeping the insulations thermal conductivity integrity and insuring the insulation system last the life of the mechanical system and avoiding the costly replacement of the insulation.

2012 & 2018 IECC Code and commentary both state that Equipment maintenance also include protection from physical damage to the pipe insulation.

The code section also requires the removal protection to shield from solar radiation that can cause degradation on of the insulation. This sometime get confused with UV protection that is under damage from "sunlight". The additional requirement to shield against solar radiation that is more than just UV , solar radiation also includes heat. Heat is a major factor in the degradation of insulation .UV testing can be unreliable as it depends on product placement.

"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 thermoplast (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"

Example of saving from protecting the insulation can be measured in Dr Kourmohammadi PE, Ph.D. CPD, CIPE, CFPE LEED AP

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 acostly expenses of replacing the insulation for maintenance.

Bibliography: Impact and Advantages of
Removable Insulation Protective Covers

Dr. "Saum" K. Nourmohammadi, PEx3, Ph.D. CPD, CIPE, CFPE,

LEED AP

2017 ASHRAE Handbook

2012, 2018 IECC Code & Commentary

Cost Impact: The code change proposal will not increase or decrease the cost of construction
There are wide varieties of removable protective coverings and are available at most supply distributors. These can be as simple as sheet metal or plastic channels, or cladding, PVC covers, Jackets, aluminum covers etc. Many covering require much less labor compared to painting or banding and they are currently being used all over the US so there no increase in cost.

Proposal # 4566

CE150-19 Part II

CE151-19 Part I

PART I — IECC: SECTION C202, 202 (New), C403.11.1

PART II — IECC: R202 (IRC N1101.6), R403.3.1 (IRC N1103.3.1)

Proponent: Jay Peters, Codes and Standards International, representing AQC Industries, TheBlueDuct (Jay@BuildingCodesAndStandards.com); Sharon Bonesteel, Salt River Project, representing Salt River Project (sharon.bonesteel@srpnet.com); Greg Johnson, representing Coalition for Fair Energy Codes (gjohnsonconsulting@gmail.com); David A Eisenberg, DCAT, representing DCAT (strawnet@gmail.com); Brent Ursenbach, WC-3 Inc, Inc., representing Utah Governors Office of Energy Development, representing State of Utah, Governors Office of Energy Development (brentu@wc-3.com)

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

2018 International Energy Conservation Code

SECTION C202 GENERAL DEFINITIONS

Add new definition as follows:

THERMAL DISTRIBUTION EFFICIENCY (TDE). The resistance to changes in air heat as air is conveyed through a distance of air duct. TDE is a heat loss calculation evaluating the difference in the heat of the air between the air duct inlet and outlet caused by differences in temperatures between the air in the duct and the duct material. TDE is expressed as a percent difference between the inlet and outlet heat in the duct.

Revise as follows:

C403.11.1 Duct and plenum insulation and sealing (Mandatory). Supply and return air ducts and plenums shall be insulated with not less than R-6 insulation where located in unconditioned spaces and where located outside the building with not less than R-8 insulation in Climate Zones 1 through 4 and not less than R-12 insulation in Climate Zones 5 through 8. Ducts located underground beneath buildings shall be insulated as required in this section or have an equivalent thermal distribution efficiency. Underground ducts utilizing the thermal distribution efficiency method shall be listed and labeled to indicate the R-Value equivalency. Where located within a building envelope assembly, the duct or plenum shall be separated from the building exterior or unconditioned or exempt spaces by not less than R-8 insulation in Climate Zones 1 through 4 and not less than R-12 insulation in Climate Zones 5 through 8.

Exceptions:

1. Where located within equipment.
2. Where the design temperature difference between the interior and exterior of the duct or plenum is not greater than 15°F (8°C).

Ducts, air handlers and filter boxes shall be sealed. Joints and seams shall comply with Section 603.9 of the International Mechanical Code.

Proposal # 4928

CE151-19 Part I

CE151-19 Part II

IECC: R202 (IRC N1101.6), R403.3.1 (IRC N1103.3.1)

Proponent: Jay Peters, Codes and Standards International, representing AQC Industries, TheBlueDuct (Jay@BuildingCodesAndStandards.com); Sharon Bonesteel, Salt River Project, representing Salt River Project (sharon.bonesteel@srpnet.com); Greg Johnson, representing Coalition for Fair Energy Codes (gjohnsonconsulting@gmail.com); David A Eisenberg, DCAT, representing DCAT (strawnet@gmail.com); Brent Urnsbach, WC-3 Inc, Inc., representing Utah Governors Office of Energy Development, representing State of Utah, Governors Office of Energy Development (brentu@wc-3.com)

2018 International Energy Conservation Code

SECTION R202 (IRC N1101.6) GENERAL DEFINITIONS

Add new definition as follows:

THERMAL DISTRIBUTION EFFICIENCY (TDE). The resistance to changes in air heat as air is conveyed through a distance of air duct. TDE is a heat loss calculation evaluating the difference in the heat of the air between the air duct inlet and outlet caused by differences in temperatures between the air in the duct and the duct material. TDE is expressed as a percent difference between the inlet and outlet heat in the duct

Revise as follows:

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. Ducts buried beneath a building shall be insulated as required per this section or have an equivalent thermal distribution efficiency. Underground ducts utilizing the thermal distribution efficiency method shall be listed and labeled to indicate the *R*-value equivalency.

Exception: Ducts or portions thereof located completely inside the building thermal envelope.

Reason: This proposal was unanimously approved by the membership at the Public Comment Hearing (PCH) based on the committee's recommendation to add a product labeling provision. It received strong support from industry (NSF, the Air Conditioning Contractors of America's National Code Committee, building and energy officials and the Membership during the PCH. The CE proposal is being resubmitted as approved with absolutely no changes or edits with hope that the membership and committee will both agree again to the merit. The residential proposal has been correlated with the commercial section for consistency. The technical aspects of the proposal were verified through rigorous testing by NSF utilizing the NSF Protocol P374. The Thermal Distribution Efficiency and R-Value equivalency is currently being printed on ducts to eliminate any confusion in the field, as requested by the committee. This modification requires the duct manufacturer to list the product and label it accordingly. *For example*, if a duct has been tested and certified to meet an *R*-10 equivalency, it will indicate on the label that the Thermal Distribution Efficiency = *R*10 Equivalency.

BACKGROUND: For decades, ICC ES PMG LC 1014 has been the only criteria used to certify underground ducts. NSF, ICC, UL and IAPMO all recognize ICC's LC1014, which specifies NSF P374 to calculate a duct's Thermal Distribution Efficiency. This provisions allows for a proven, energy efficient methodology to be used, and eliminates unnecessary insulation when a duct material exhibits an equally efficient method to deliver conditioned air, saving material and energy. This is not proprietary and multiple manufacturers have certified to ICC LC 1014 and the NSF Protocol for Thermal Distribution Efficiency. TDE is only used for ducts buried

beneath building and does not eliminate or restrict insulated ducts from their current compliance path utilizing the traditional R-value method. It is merely another path for cutting edge products to meet the intent of the code.

Bibliography: ICC ES Listing Criteria LC1014 Underground Ducts
NSF Protocol P374 Thermal Distribution Efficiency of Underground Ducts

Cost Impact: The code change proposal will decrease the cost of construction
By not requiring additional and unnecessary insulation on ducts underneath buildings, it could actually save construction costs.

Proposal # 5693

CE151-19 Part II

CE152-19

IECC: C403.11.2.3

Proponent: Brent Ursenbach, WC-3, representing State of Utah, Governors Office of Energy Development (brentu@wc-3.com)

2018 International Energy Conservation Code

Revise as follows:

C403.11.2.3 High-pressure duct systems (Mandatory). Ducts and plenums designed to operate at static pressures equal to or greater than 3 inches water gauge (747 Pa) shall be insulated and sealed in accordance with Section C403.11.1. In addition, ducts and plenums shall be leak tested in accordance with the SMACNA HVAC Air Duct Leakage Test Manual and shown to have a rate of air leakage (CL) less than or equal to 4.0 as determined in accordance with Equation 4-8.

$$CL = F/P^{0.65}$$

(Equation 4-8)

where:

F = The measured leakage rate in cfm per 100 square feet of duct surface.

P = The static pressure of the test.

Documentation shall be furnished by the designer demonstrating that representative sections totaling not less than 25 percent of the duct area have been tested and that all tested sections comply with the requirements of this section.

Reason: The designer does not perform the leak testing required by this section. Certainly the test requires documentation; however, it may be provided by the general contractor, mechanical contractor, test and balance contractor, or other qualified individuals or organizations, as approved by the AHJ.

Cost Impact: The code change proposal will not increase or decrease the cost of construction. The proposal simply removes the designer as the sole provider of duct testing documentation. The testing requirements remain unchanged.

Proposal # 5629

CE152-19

CE153-19

IECC: C403.11.3

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

C403.11.3 Piping insulation (Mandatory). Piping serving as part of a heating or cooling system shall be thermally insulated in accordance with Table C403.11.3.

Exceptions:

1. Factory-installed piping within HVAC equipment tested and rated in accordance with a test procedure referenced by this code.
2. Factory-installed piping within room fan-coils and unit ventilators tested and rated according to AHRI 440 (except that the sampling and variation provisions of Section 6.5 shall not apply) and AHRI 840, respectively.
3. Piping that conveys fluids that have a design operating temperature range between 60°F (15°C) and 105°F (41°C).
4. Piping that conveys fluids that have not been heated or cooled through the use of fossil fuels or electric power.
5. Strainers, control valves, and balancing valves associated with piping 1 inch (25 mm) or less in diameter.
6. Direct buried piping that conveys fluids at or below 60°F (15°C).
7. In radiant heating systems, sections of piping intended by design to radiate heat.

Reason: Why is the proposed code change needed?

The table insulation requirements could be misinterpreted to require insulation on piping used for radiant heating, which would be counterproductive to how radiant heat systems work. This change clarifies that active sections of piping used for radiant heat do not require insulation,

Why is the proposed code change a reasonable solution? It clarifies the table requirements

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

The Intent of this change is to not insulate radiant heating system piping to reduce the heat it provides to a space. That is the intent of a Radiant system. This change will save money by allowing the system to work as designed.

Proposal # 5132

CE153-19

CE154-19

IECC: C202 (New); C403.13(New); Table C403.13(New); Chapter 6CE DOE(NEW); DOD(NEW)

Proponent: Connor Barbaree, representing ASHRAE (cbarbaree@ashrae.org)

2018 International Energy Conservation Code

SECTION C202 GENERAL DEFINITIONS

Add new definition as follows:

Best Efficiency Point. The pump hydraulic power operating point, consisting of both flow and head conditions, that results in the maximum efficiency.

PEI_{CL}. The pump energy index for a constant load (hp) (kW).

PER_{CL}. The pump energy rating for a constant load (hp) (kW), determined in accordance with either testing for bare pumps, pumps sold with single-phase induction motors, and pumps sold with drivers other than electric motors, or testing for pumps sold with motors and rated using the testing-based approach, or testing for pumps sold with motors and rated using the calculation-based approach.

PER_{STD}. The *PER_{CL}* for a pump that is minimally compliant with Subpart Y of 10 CFR, Part 431, with the same flow and specific speed characteristics as the tested pump (hp/kW).

PEI_{VL}. The pump energy index for a variable load.

PER_{VL}. The pump energy rating for a variable load (hp) (kW) determined in accordance with testing for pumps sold with motors and continuous or non-continuous controls rated using the testing-based approach, or testing for pumps sold with motors and continuous controls rated using the calculation-based approach.

PUMP Equipment designed to move liquids that does or does not include entrained gases, free solids, and totally dissolved solids by physical or mechanical action and includes a bare pump and, if included by the manufacturer at the time of sale, mechanical equipment, driver, and controls.

Clean Water Pump. A device that is designed for use in pumping water with a maximum non-absorbent free solid content of 0.016 pounds per cubic foot (0.26 kilograms per cubic meter), and with a maximum dissolved solid content of 3.1 pounds per cubic foot (50 kilograms per cubic meter), provided that the total gas content of the water does not exceed the saturation volume, and disregarding any additives necessary to prevent the water from freezing at a minimum of 14°F (-10°C).

End Suction Close-Coupled (ESCC) Pump. A close-coupled, dry rotor, end suction device that has a shaft input power greater than or equal to 1.0 horsepower (0.75 kW) and less than or equal to 200 horsepower (150 kW) at its *Best Efficiency Point (BEP)* and full impeller diameter and that is not a dedicated-purpose pool pump. It is also a single-stage, rotodynamic pump in which the liquid enters the bare pump in a direction parallel to the impeller shaft and on the side opposite the bare pump's driver-end, and is then discharged through a volute in a plane perpendicular to the shaft.

End Suction Frame Mounted/Own Bearings (ESFM) Pump. A mechanically-coupled, dry rotor, end suction device that has a shaft input power greater than or equal to 1.0 horsepower (0.75 kW) and less than or equal to 200 horsepower (150 kW) at its *Best Efficiency Point (BEP)* and full impeller diameter and that is not a dedicated-purpose pool pump. It is also a single-stage, rotodynamic pump in which the liquid enters the bare

pump in a direction parallel to the impeller shaft and on the side opposite the bare pump's driver-end, and is then discharged through a volute in a plane perpendicular to the shaft.

In-Line (IL) Pump. A device that is either a twin-head pump or a single-stage, single-axis flow, dry rotor, rotodynamic pump that has a shaft input power greater than or equal to 1.0 horsepower (0.75 kW) and less than or equal to 200 horsepower (150 kW) at its *Best Efficiency Point (BEP)* and full impeller diameter, in which liquid is discharged through a volute in a plane perpendicular to the shaft. Such pumps do not include pumps that are mechanically coupled or close-coupled, have a pump power output that is less than or equal to 5.0 horsepower (3.7 kW) at its *Best Efficiency Point (BEP)* at full impeller diameter, and are distributed in commerce with a horizontal motor.

Radially Split, Multi-Stage, Vertical, In-Line Diffuser Casing (RSV) Pump. A device that is a vertically suspended, multi-stage, single axis flow, dry rotor, rotodynamic pump complies with all of the following:

1. Has a shaft input power greater than or equal to 1.0 horsepower (0.75 kW) and less than or equal to 200 horsepower (150 kW) at its *Best Efficiency Point (BEP)* and full impeller diameter and at the number of stages required for testing,
2. In which liquid is discharged in a place perpendicular to the impeller shaft.
3. For which each stage or bowl, consists of an impeller and diffuser.
4. For which no external part of such a pump is designed to be submerged in the pumped liquid.

Submersible Turbine (ST) Pump. A device that is a single-stage or multi-stage, dry rotor, rotodynamic pump that is designed to be operated with the motor and stage(s) fully submerged in the pumped liquid; that has a shaft input power greater than or equal to 1.0 horsepower (0.75 kW) and less than or equal to 200 horsepower (150 kW) at its *Best Efficiency Point (BEP)* and full impeller diameter and at the number of stages required for testing; and in which each stage of this pump consists of an impeller and diffuser, and liquid enters and exits each stage of the bare pump in a direction parallel to the impeller shaft.

Add new text as follows:

C403.13 Pumping equipment performance requirements (Mandatory). Clean water pumps meeting the following criteria shall meet the efficiency requirements shown in Table C403.13: when tested and rated in accordance with the applicable test procedure.

1. A flow rate of 25 gallons per minute (0.0016 cubic meters per second) or greater at its Best Efficiency Point (BEP) at full impeller diameter;
2. Maximum head of 459 feet (140 meters) at its Best Efficiency Point (BEP) at full impeller diameter and the number of stages required for testing;
3. Design temperature range from 14 to 248 °F (-10 to 120 °C);
4. Designed to operate with either:
 - 4.1. A 2- or 4-pole induction motor; or
 - 4.2. A non-induction motor with a speed of rotation operating range that includes speeds of rotation between 2,880 and 4,320 revolutions per minute and/or 1,440 and 2,160 revolutions per minute; and
 - 4.3. In either 4.1 or 4.2, the driver and impeller must rotate at the same speed;
5. For submersible turbine pumps, a 6-inch (15 centimeters) or smaller bowl diameter; and
6. For end suction close-coupled pumps and end suction frame mounted/own bearings pumps specific speed less than or equal to 5,000 rpm when calculated using U.S. customary units.

Exceptions:

1. Fire pumps.

2. Self-priming pumps.
3. Prime-assist pumps.
4. Magnet driven pumps.
5. Pumps designed to be used in a nuclear facility subject to 10 CFR part 50.
6. Pumps meeting the design and construction requirements set forth in MIL–P–17639F, MIL–P–17881D, MIL–P–17840C, MIL–P–18682D, and MIL–P–18472G.

Table C403.13
Efficiency Requirements Pumps

Maximum PEI for Pumps Manufactured on or after January 27, 2020

<u>Pump Type</u>	<u>Nominal Speed of Rotation (rpm)</u>	<u>Operating Mode</u>	<u>Maximum PEI^a</u>	<u>C-value^b</u>	<u>Test Procedure</u>
<u>End Suction, Close Coupled</u>	<u>1800</u>	<u>Constant Load</u>	<u>1.00</u>	<u>128.47</u>	<u>10 CFR Part 431</u>
<u>End Suction, Close Coupled</u>	<u>3600</u>	<u>Constant Load</u>	<u>1.00</u>	<u>130.42</u>	
<u>End Suction, Close Coupled</u>	<u>1800</u>	<u>Variable Load</u>	<u>1.00</u>	<u>128.47</u>	
<u>End Suction, Close Coupled</u>	<u>3600</u>	<u>Variable Load</u>	<u>1.00</u>	<u>130.42</u>	
<u>End Suction, Frame Mounted</u>	<u>1800</u>	<u>Constant Load</u>	<u>1.00</u>	<u>128.85</u>	
<u>End Suction, Frame Mounted</u>	<u>3600</u>	<u>Constant Load</u>	<u>1.00</u>	<u>130.99</u>	
<u>End Suction, Frame Mounted</u>	<u>1800</u>	<u>Variable Load</u>	<u>1.00</u>	<u>128.85</u>	
<u>End Suction, Frame Mounted</u>	<u>3600</u>	<u>Variable Load</u>	<u>1.00</u>	<u>130.99</u>	
<u>In-Line</u>	<u>1800</u>	<u>Constant Load</u>	<u>1.00</u>	<u>129.30</u>	
<u>In-Line</u>	<u>3600</u>	<u>Constant Load</u>	<u>1.00</u>	<u>133.84</u>	
<u>In-Line</u>	<u>1800</u>	<u>Variable Load</u>	<u>1.00</u>	<u>129.63</u>	
<u>In-Line</u>	<u>3600</u>	<u>Variable Load</u>	<u>1.00</u>	<u>133.20</u>	
<u>Radially Split, Vertical</u>	<u>1800</u>	<u>Constant Load</u>	<u>1.00</u>	<u>129.63</u>	
<u>Radially Split, Vertical</u>	<u>3600</u>	<u>Constant Load</u>	<u>1.00</u>	<u>133.20</u>	
<u>Radially Split, Vertical</u>	<u>1800</u>	<u>Variable Load</u>	<u>1.00</u>	<u>129.63</u>	
<u>Radially Split, Vertical</u>	<u>3600</u>	<u>Variable Load</u>	<u>1.00</u>	<u>133.20</u>	
<u>Submersible Turbine</u>	<u>1800</u>	<u>Constant Load</u>	<u>1.00</u>	<u>138.78</u>	
<u>Submersible Turbine</u>	<u>3600</u>	<u>Constant Load</u>	<u>1.00</u>	<u>134.85</u>	

Submersible Turbine	1800	Variable Load	1.00	138.78
Submersible Turbine	3600	Variable Load	1.00	134.85

a. For pumps with the Constant Load operating mode, the relevant PEI is PEI_{CL} . For pumps with the Variable Load operating mode the relevant PEI is PEI_{VL} .

b. The C-values shown in this table shall be used in the equation for PER_{STD} when calculating PEI_{CL} or PEI_{VL} .

Add new standard(s) as follows:

DOE

U.S. Department of Energy
c/o Superintendent of Documents
1000 Independence Avenue SW
Washington DC 20585

10 CFR Part 50: Domestic Licensing of Production and Utilization Facilities

DOD

U.S. Department of Defense
Naval Sea Systems Command
Department of the Navy
Washington Navy Yard
Washington DC 20362
US

MIL-P-18472G-1989: Pump, Centrifugal, Condensate, Feed Booster, Waste Heat Boiler and Distilling Plant

DOD

U.S. Department of Defense
Naval Sea Systems Command
Department of the Navy
Washington Navy Yard
Washington DC 20362
US

MIL-P-18682D-1984: Pump, Centrifugal, Main Condenser Circulating, Naval Shipboard

DOD

U.S. Department of Defense
Naval Sea Systems Command
Department of the Navy
Washington Navy Yard
Washington DC 20362
US

MIL-P-17881D-1972: Pump, Centrifugal, Boiler Feed, (Multi Stage)

DOD

U.S. Department of Defense
Naval Sea Systems Command
Department of the Navy
Washington Navy Yard
Washington DC 20362
US

DOD

U.S. Department of Defense
Naval Sea Systems Command
Department of the Navy
Washington Navy Yard
Washington DC 20362
US

MIL-P-17840-D-2018: Pump, Centrifugal, Close Coupled, Navy Standard for Use on Naval Ships

Reason: In January, 2016, the U.S. Department of Energy published a final rule for energy conservations standards for commercial and industrial clean water pumps that will go into effect as of January 27, 2020. This addendum provides a new table of information about the new efficiency requirements. It also provides new definitions that are needed to accompany the table.

This proposal will have an energy savings impact in those buildings that use clean water pumps. According to the DOE analysis, the simple payback for the pumps ranges from 0.8 to 3.1 years.

This information will help energy code officials ensure that installed clean water pumps are meeting the federal efficiency standards on or after January 2020.

The formula for efficiency is shown below (and is copied from the DOE Technical Support Document, December 2015):

<https://www.regulations.gov/document?D=EERE-2011-BT-STD-0031-0056>

$$\eta_{pump,STD} = -0.8500 * \ln(Q)^2 - 0.3800 * \ln(Ns) * \ln(Q) - 11.480 * \ln(Ns)^2 + 17.800 * \ln(Q) + 179.80 * \ln(Ns) - (C + 555.60)$$

Where:

Q = flow at BEP at full impeller diameter and nominal speed (gpm),

Ns = specific speed at 60 Hz and calculated using U.S. customary units, and

C = a constant that is set for the surface, which is set based on the speed of rotation and equipment type of the pump model.

“The minimally compliant PER is unique to each pump model and is a function of each pump model’s flow at BEP and specific speed. This function is an equation that represents the attainable hydraulic efficiency of pumps for a given flow and specific speed. All of the terms of the polynomial function are the same for all efficiency levels and classes of pumps for the DOE analysis, except for the constant parameter. This parameter, the “C-value,” is unique for each combination of equipment class and efficiency level. Changing the C-value moves the otherwise fixed-shape surface to higher or lower efficiency. Because the function was developed to represent the inherent pump efficiency trends as flow and specific speed change, the C-value can be used to define an efficiency level, which is equally stringent for all pumps across the scope of flow and specific speed. By adjusting the C-value, DOE can establish different efficiency levels that represent different efficiency percentiles.

For this final rule the three-dimensional polynomial efficiency equation discussed in the previous paragraph is

based on the EU minimum efficiency index (MEI) equation but is adapted to account for the use of English units and the 60 Hz electrical input power found in the United States. The converted equation is shown in Equation 5.1.”

Bibliography: U.S. Department of Energy, *Technical Support Document: Energy Efficiency Program for Consumer Products and Commercial and Industrial Equipment: Pumps*, Washington DC, December 2015.

<https://www.regulations.gov/document?D=EERE-2011-BT-STD-0031-0056>

U.S. Department of Energy, *Energy Conservation Program: Energy Conservation Standards for Pumps; Final Rule*, Washington DC, January 26, 2016. <https://www.regulations.gov/document?D=EERE-2011-BT-STD-0031-0060>

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

Costs will increase due to the incremental cost increases associated with the new efficiency standards for clean water pumps. Based on analysis performed by the US Department of Energy, the incremental costs of increased efficiency of the federally regulated clean water pumps will be recovered with 3.1 years.

Analysis: A review of the standards proposed for inclusion in the code, 10 CFR part 50, MIL–P–17639F, MIL–P–17881D, MIL–P–17840C, MIL–P–18682D, and MIL–P–18472G. 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.

Proposal # 4871

CE154-19

CE156-19

IECC: C404.2.1

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

2018 International Energy Conservation Code

Revise as follows:

C404.2.1 High input service water-heating systems. Gas-fired water-heating equipment installed in new buildings shall be in compliance with this section. Where a singular piece of water-heating equipment serves the entire building and the input rating of the equipment is 1,000,000 Btu/h (293 kW) or greater, such equipment shall have a thermal efficiency, E_t , of not less than ~~90~~92 percent. Where multiple pieces of water-heating equipment serve the building and the combined input rating of the water-heating equipment is 1,000,000 Btu/h (293 kW) or greater, the combined input-capacity-weighted-average thermal efficiency, E_t , shall be not less than 90 percent.

Exceptions:

1. Where not less than 25 percent of the annual service water-heating requirement is provided by on-site renewable energy or site-recovered energy, the minimum thermal efficiency requirements of this section shall not apply.
2. The input rating of water heaters installed in individual dwelling units shall not be required to be included in the total input rating of service water-heating equipment for a building.
3. The input rating of water heaters with an input rating of not greater than 100,000 Btu/h (29.3 kW) shall not be required to be included in the total input rating of service water-heating equipment for a building.

Reason: Section C404.2.1 addresses not just typical commercial service water heating loads like laundries; it also addresses larger boilers used for central heating in R-occupancies. Water heating is one of the largest loads in R-1 (hotels) and R-2 (multifamily) occupancies. It composes around 25-35% of the total building load in typical multifamily buildings. This makes this an important provision of the energy code. However, while federal minimums and boiler markets have advanced, this provision has not been updated. Therefore, the performance premium that this provision requires has eroded over time.

This proposal includes a modest increase in the efficiency requirement for C404.2.1 from 90% E_t to 92% E_t . This improvement can be met without making major technology shifts since achieving a 90% E_t already generally requires condensing technology. Of the 2782 boilers that meet the 1,000,000 Btu/h threshold, 852 meet the existing 90% requirement and 792 meet a requirement of 92% E_t , so market availability will be minimally impacted.

Savings for this proposal are significant. Using the high-rise multifamily model developed by Pacific Northwest National Lab's determination study of the 2015 IECC, savings from this proposal would range from 2.3%-4.0% whole-building energy savings depending on climate zone. While 2015 is not exactly the same as 2018, the water heating provisions are very similar so the savings should be reasonably representative of savings for 2018.

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

This proposal could have a limited impact on cost. However, it only eliminates about 7% of the boilers that meet the existing requirement, so the impact should be minimal.

CE157-19

IECC: C404.4

Proponent: Mitchell Tidwell, Ridgeway Plumbing, Inc., representing Ridgeway Plumbing, Inc.

2018 International Energy Conservation Code

Revise as follows:

C404.4 Insulation of piping. ~~Piping from a water heater to the termination of the heated water fixture supply pipe. The following piping shall be insulated to levels indicated in accordance with Table C403.11.3. On both the inlet and outlet piping of a storage water heater or heated water storage tank, the piping to a heat trap or the first 8 feet (2438 mm) of piping, whichever is less, shall be insulated. Piping that is heat traced shall be insulated in accordance with Table C403.11.3 or the heat trace manufacturer's instructions. Tubular pipe insulation shall be installed in accordance with the insulation manufacturer's instructions. Pipe insulation shall be continuous except where the piping passes through a framing member. The minimum insulation thickness requirements of this section shall not supersede any greater insulation thickness requirements necessary for the protection of piping from freezing temperatures or the protection of personnel against external surface temperatures on the insulation.~~

Exception: ~~Tubular pipe insulation shall not be required on the following:~~

- ~~1. Recirculating system piping, other than the cold-water piping of demand recirculating systems, including the supply and return piping of a circulating tank type water heater.~~
- ~~2. The first 8 feet of outlet piping for a constant-temperature non-recirculating storage system.~~
- ~~3. The first 8 feet of branch piping connected to a recirculated, heat-traced, or impedance heated piping.~~
- ~~4. The inlet piping between the storage tank and a heat trap in a non-recirculating storage system.~~

Piping that is externally heated, such as heat trace or impedance heating, shall be insulated to levels indicated in Table C403.11.3 or the heat trace manufacturer's instructions.

- ~~1. The tubing from the connection at the termination of the fixture supply piping to a plumbing fixture or plumbing appliance.~~
- ~~2. Valves, pumps, strainers and threaded unions in piping that is 1 inch (25 mm) or less in nominal diameter.~~
- ~~3. Piping from user-controlled shower and bath mixing valves to the water outlets.~~
- ~~4. Cold water piping of a demand recirculation water system.~~
- ~~5. Tubing from a hot drinking water heating unit to the water outlet.~~
- ~~6. Piping at locations where a vertical support of the piping is installed.~~
- ~~7. Piping surrounded by building insulation with a thermal resistance (R-value) of not less than R-3.~~

Reason: The 2015 IECC established new insulation requirements for hot water piping. The code now requires that every inch of concealed hot water piping be insulated with minimum 1-inch thick insulation. This now includes even non-circulated hot water piping and branches. As the plumbing industry wakes up to the new requirements, they are proving to be excessive, expensive, and unworkable.

The level of hot water insulation now far exceeds that found in ASHRAE 90.1-2016. Although it has always made sense to insulate the hot water mains and returns of recirculating systems, there is little to gain by insulating non-circulated branch piping, which tends to cool rather quickly due to infrequent demand – whether insulated or not. Plumbing hot water pipes are typically 110-120° F, and are generally installed in interior wall cavities averaging 70° F. And much of today's water piping is plastic – CPVC or PEX - with insulative properties

that greatly exceed that of copper.

The additional cost of insulating all of these non-circulated branches far outweighs any perceived payback. Recirculating loops are typically located in roomy ceiling spaces; branch piping usually runs inside cramped 3-1/2-inch frame walls. With insulated pipe measuring 2-1/2 to 3 inches O.D., installation can be difficult and time-consuming inside congested walls (and *impossible* on single- or double-furred block walls.) The extra cost in labor and materials to insulate CPVC hot water pipes running inside a wall can be several times the cost of the pipe itself. Often there is just no way to comply with the code. Multi-family buildings are especially affected.

This proposal restores the actual ASHRAE 90.1 requirements. Hot water recirculating piping would be insulated. So would the first 8 feet of branch piping emanating from the circulating loop. So would the first 8 feet of outlet piping from the heated water source. This amount of hot water insulation is actually greater than previous ASHRAE standards. And it achieves a more reasonable balance between energy savings and installation costs.

I urge the committee to carefully consider the real world impact of the current hot water insulation requirements and to approve this sensible fix.

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

By eliminating unnecessary hot water branch piping insulation, this proposal will reduce the cost of plumbing by \$200 – \$300 per unit for a typical two-bathroom apartment.

Proposal # 4113

CE157-19

CE158-19

IECC: C404.5.2.1

Proponent: Michael Cudahy, PPFA, representing PPFA Plastic Pipe and Fittings Association
(mikec@cmservices.com)

2018 International Energy Conservation Code

Revise as follows:

C404.5.2.1 Water volume determination. The volume shall be the sum of the internal volumes of pipe, fittings, valves, meters and manifolds between the nearest source of heated water and the termination of the fixture supply pipe. The volume in the piping shall be determined from the "Volume" column in Table ~~G404.5.1~~ C404.5.1 or from Table E202.1 of the International Plumbing Code. The volume contained within fixture shutoff valves, within flexible water supply connectors to a fixture fitting and within a fixture fitting shall not be included in the water volume determination. Where heated water is supplied by a recirculating system or heat-traced piping, the volume shall include the portion of the fitting on the branch pipe that supplies water to the fixture.

Reason: Table E202.1 in the IPC, "Internal Volume of Various Water Distribution Tubing" is well suited for this calculation and should be specifically included as an option in calculations for the section. The table is shown below.

TABLE E202.1 - INTERNAL VOLUME OF VARIOUS WATER DISTRIBUTION TUBING

OUNCES OF WATER PER FOOT OF TUBE								
Size Nominal, Inch	Copper Type M	Copper Type L	Copper Type K	CPVC CTS SDR 11	CPVC SCH 40	CPVC SCH 80	PE- RT SDR 9	Composite F 121
3/8	1.06	0.97	0.84	N/A	1.17	—	0.64	0.66
1/2	1.69	1.55	1.45	1.25	1.89	1.46	1.18	1.31
3/4	3.43	3.22	2.90	2.67	3.38	2.74	2.35	3.39
1	5.81	5.49	5.17	4.43	5.53	4.57	3.91	5.56
1 1/4	8.70	8.36	8.09	6.61	9.66	8.24	5.81	8.49
1 1/2	12.18	11.83	11.45	9.22	13.20	11.38	8.09	13.8
2	21.08	20.58	20.04	15.79	21.88	19.11	13.86	21.4

For SI: 1 ounce = 0.030 liter.

Bibliography: None

Cost Impact: The code change proposal will not increase or decrease the cost of construction. The addition of the method of calculation is not expected to increase or decrease the cost of construction, it is simply a more accurate method for determining volume.

Staff Analysis: The table referenced is in Appendix E of the IPC.

CE159-19 Part I

PART I — IECC: C404.6.1, C404.7

PART II — IECC: R403.5.1.1 (IRC N1103.5.1.1), R403.5.2 (IRC N1103.5.2)

Proponent: Anthony Floyd, City of Scottsdale, representing City of Scottsdale (afloyd@scottsdaleaz.gov)

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

2018 International Energy Conservation Code

Revise as follows:

C404.6.1 Circulation systems. Heated-water circulation systems shall be provided with a circulation pump. The system return pipe shall be a dedicated return pipe or a cold water supply pipe. Gravity and thermo-syphon circulation systems shall be prohibited. Controls for circulating hot water system pumps shall start the pump based on the identification of a demand for hot water within the occupancy. The controls shall automatically turn off the pump when the water in the circulation loop is at the desired temperature and when there is not a demand for hot water. The controls shall limit the temperature of the water entering the cold-water piping to not greater than 104°F (40°C).

~~C404.7~~ C404.6.1.1 Demand recirculation controls. 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).~~

Proposal # 5415

CE159-19 Part I

CE159-19 Part II

IECC: R403.5.1.1 (IRC N1103.5.1.1), R403.5.2 (IRC N1103.5.2)

Proponent: Anthony Floyd, City of Scottsdale, representing City of Scottsdale (afloyd@scottsdaleaz.gov)

2018 International Energy Conservation Code

Revise as follows:

R403.5.1.1 (IRC N1103.5.1.1) Circulation systems. Heated water circulation systems shall be provided with a circulation pump. The system return pipe shall be a dedicated return pipe or a cold water supply pipe. Gravity and thermosyphon circulation systems shall be prohibited. Controls for circulating hot water system pumps shall start the pump based on the identification of a demand for hot water within the occupancy. The controls shall automatically turn off the pump when the water in the circulation loop is at the desired temperature and when there is no demand for hot water. The controls shall limit the temperature of the water entering the cold-water piping to not greater than 104°F (40°C).

~~**R403.5.2 (IRC N1103.5.2)**~~ **R403.5.1.1.1 (IRC N1103.5.1.1.1) Demand recirculation water systems.** 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: This code change clarifies the requirements for heated water circulation and demand recirculation systems. Section R403.5.2 - 'Demand recirculation water systems' is moved and renumbered as a subsection to R403.5.1.1 - 'Circulation systems' because demand recirculation is a type of 'circulation system' with specific demand-initiated control requirements.

The temperature limit for cold-water return piping, item 2 of 'Demand recirculation water systems' is relocated to the body of section R403.5.1.1 (circulation systems) because this provision pertains to all heated water circulation systems that use cold-water piping as a return to the water-heating equipment.

This code change clarifies the intent of this section for the energy efficient delivery of hot water by correlating the existing provisions for circulation and demand recirculation water systems. These provisions are only applicable when heated water circulation and demand recirculation systems are installed.

Cost Impact: The code change proposal will not increase or decrease the cost of construction
This code change does not add any new requirements.

Proposal # 5417

CE159-19 Part II

CE160-19 Part I

PART I — IECC: Part I: C404.9.1, C404.9.3, C404.10

IECC Part II: R403.10 (N1103.10). R403.10.2 (N1103.10.2), R403.10.3(N1103.10.3), R403.12 (N1103.12)

PART II — IECC: R403.10 (IRC N1103.10), R403.10.1 (IRC N1103.10.1), R403.10.3 (IRC N1103.10.3), R403.12 (IRC N1103.12)

Proponent: Jennifer Hatfield, representing Association of Pool & Spa Professionals
(jen@jhatfieldandassociates.com)

2018 International Energy Conservation Code

C404.9 Energy consumption of pools and permanent spas (Mandatory). The energy consumption of pools and permanent spas shall be controlled by the requirements in Sections C404.9.1 through C404.9.3.

Revise as follows:

C404.9.1 Heaters. The electric power to all heaters shall be controlled by ~~an~~ 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 ~~in a location with ready access~~. 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.

C404.9.2 Time switches. Time switches or other control methods that can automatically turn off and on heaters and pump motors according to a preset schedule shall be installed for heaters and pump motors. Heaters and pump motors that have built-in time switches shall be in compliance with this section.

Exceptions:

1. Where public health standards require 24-hour pump operation.
2. Pumps that operate solar- and waste-heat-recovery pool heating systems.

C404.9.3 Covers. Outdoor heated pools and outdoor permanent spas shall be provided with a vapor-retardant cover or other *approved* vapor-retardant means.

Exception: Where more than ~~75~~ 70 percent of the energy for heating, computed over an operating season ~~of not fewer than 3 calendar months~~, is ~~from site-recovered energy such as~~ from a heat pump or ~~on-site renewable solar energy system source~~, covers or other vapor-retardant means shall not be required.

C404.10 ~~Energy consumption of portable~~ Portable spas (Mandatory). The energy consumption of electric-powered portable spas shall be controlled by the requirements of APSP 14.

Proposal # 5571

CE160-19 Part I

CE160-19 Part II

IECC: R403.10 (IRC N1103.10), R403.10.1 (IRC N1103.10.1), R403.10.3 (IRC N1103.10.3), R403.12 (IRC N1103.12)

Proponent: Jennifer Hatfield, representing Association of Pool & Spa Professionals
(jen@jhatfieldandassociates.com)

2018 International Energy Conservation Code

Revise as follows:

R403.10 (IRC N1103.10) ~~Pools~~ Energy consumption of pools and permanent spa-energy consumption spas (Mandatory). The energy consumption of pools and permanent spas shall be controlled by the requirements in ~~accordance with~~ Sections R403.10.1 through R403.10.3.

R403.10.1 (IRC 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.

R403.10.2 (IRC N1103.10.2) Time switches. Time switches or other control methods that can automatically turn off and on heaters and pump motors according to a preset schedule shall be installed for heaters and pump motors. Heaters and pump motors that have built-in time switches shall be in compliance with this section.

Exceptions:

1. Where public health standards require 24-hour pump operation.
2. Pumps that operate solar- and waste-heat-recovery pool heating systems.

R403.10.3 (IRC N1103.10.3) Covers. Outdoor heated pools and outdoor permanent spas shall be provided with a vapor-retardant cover or other *approved* vapor-retardant means.

Exception: Where more than ~~75~~ 70 percent of the energy for heating, computed over an operation season of ~~not less than three calendar months~~, is from a heat pump or ~~an on-site renewable solar energy system source~~, covers or other vapor-retardant means shall not be required.

R403.11 (IRC N1103.11) Portable spas (Mandatory). The energy consumption of electric-powered portable spas shall be controlled by the requirements of APSP-14.

R403.12 (IRC N1103.12) Residential pools and permanent residential ~~spas- spas~~ (Mandatory). Residential The energy consumption of 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 controlled in accordance with the requirements of APSP 15.

Reason: This proposal aligns the energy efficiency provisions of the IECC for residential pools, spas and portable spas (hot tubs) with those found in the 2018 International Swimming Pool & Spa Code. A similar proposal has been submitted to ensure IECC commercial provisions are also aligned with the ISPSC pool & spa energy efficiency provisions found within Section 303.

Without this proposal a jurisdiction who adopts both the IECC and ISPSC will have conflicting code requirements addressing covers for outdoor heated pools and outdoor permanent spas. Therefore, this proposal is simply

making the exception language for a vapor-retardant cover consistent with what exists in the ISPSC. The ISPSC has always used a 70% threshold computed over an operation season – there is no minimum operating season in the ISPSC due to the fact depending on the part of the country, an operating season can be from as little as a few months to an entire year.

The reality is after the pool or spa is installed and final inspection has occurred, there is no way to ensure a cover is being put back on after every use; therefore, encouraging use of more energy efficient heating systems by providing an exception from the vapor-retardant cover provides a greater chance of energy savings. Having consistent language on how that exception is intended to work in the ISPSC, IECC Commercial and IECC Residential is critical.

The proposed change also adds in the word “mandatory” in section R403.12 for consistency with R403.10 and R403.11, as all provisions listed are mandatory with no other alternative. Further, R403.12 requires residential pools and permanent spas to meet the ANSI/APSP/ICC 15 Standard.

The remaining code proposal language is simply cleanup to reflect consistent verbiage used between the two I-codes, because the pool & spa energy efficiency language is not completely consistent when comparing the IECC to the ISPSC. Further, within the IECC the commercial and residential provisions slightly differ as well. Although the remaining differences are minor and may not affect the intent, eliminating differences do lessen the chance of interpretation errors.

By adopting this code change, a jurisdiction that adopts both the ISPSC and IECC, which is increasingly more likely and already exists in many cases (over 20 states and 160 localities have adopted the ISPSC), will not be left with conflicting code requirements. Rather, they will co-exist by providing consistent requirements that follow the original intent.

Bibliography: 2018 ISPSC, Section 303 and 2018 IECC, Section C404.9

Cost Impact: The code change proposal will not increase or decrease the cost of construction. The code change should not affect the cost of construction but for any costs associated with differing provisions found within the current ISPSC and IECC editions, if the change is not adopted. The proposal simply ensures the IECC has consistent energy efficiency requirements for residential pools and spas from what is found in the ISPSC.

Proposal # 5558

CE160-19 Part II

CE161-19

IECC: C202, C405.1, C405.2.3

Proponent: Jack Bailey, representing International Association of Lighting Designers (jbailey@oneluxstudio.com); Glenn Heinmiller, Lam Partners, representing International Association of Lighting Designers (glenn@lampartners.com)

2018 International Energy Conservation Code

Revise as follows:

GENERAL LIGHTING. ~~Lighting~~ Interior lighting that provides a substantially uniform level of illumination throughout an area. ~~General lighting shall not include decorative lighting or lighting that provides a dissimilar level of illumination to serve a specialized application or feature within such area.~~ a space.

C405.1 General (Mandatory). This section covers lighting system controls, the maximum lighting power for interior and exterior applications and electrical energy consumption.
Dwelling units within multifamily buildings shall comply with Section R404.1. All other dwelling units shall comply with Section R404.1, or with Sections C405.2.4 and C405.3. Sleeping units shall comply with Section C405.2.4, and with Section R404.1 or C405.3. Lighting installed in walk-in coolers, walk-in freezers, refrigerated warehouse coolers and refrigerated warehouse freezers shall comply with the lighting requirements of Section C403.10.1 or

~~C403.10.2.~~

C403.10.2. General lighting shall consist of all lighting included when calculating the total connected interior lighting power in accordance with Section C405.3.1 and which does not require specific application controls in accordance with Section C405.2.4.

C405.2.3 Daylight-responsive controls. Daylight-responsive controls complying with Section C405.2.3.1 shall be provided to control the ~~electric lights~~ general lighting within daylight zones in the following spaces:

1. Spaces with a total of more than 150 watts of ~~general~~ general lighting within sidelit zones complying with Section C405.2.3.2 ~~General lighting does not include lighting that is required to have specific application control in accordance with Section C405.2.4.~~
2. Spaces with a total of more than 150 watts of general lighting within toplit zones complying with Section C405.2.3.3.

Exceptions: Daylight responsive controls are not required for the following:

1. Spaces in health care facilities where patient care is directly provided. ~~2. Lighting that is required to have specific application control in accordance with Section C405.2.4.~~
3. Sidelit zones on the first floor above grade in Group A-2 and Group M occupancies.
4. New buildings where the total connected lighting power calculated in accordance with Section C405.3.1 is not greater than the adjusted interior lighting power allowance (LPA_{adj}) calculated in accordance with Equation 4-9

$$LPA_{adj} = \left[\frac{LPA_{norm}}{TBFA} \right] \times (1.0 - 0.4 \times UDZFA)$$

(Equation 4-9)

where:

LPA_{adj} = Adjusted building interior lighting power allowance in watts.

LPA_{norm} = Normal building lighting power allowance in watts calculated in accordance with Section C405.3.2 and reduced in accordance with Section C406.3 where Option 2 of Section C406.1 is used to comply with the requirements of Section C406.

UDZFA = Uncontrolled daylight zone floor area is the sum of all sidelit and toplit zones, calculated in accordance with Sections C405.2.3.2 and C405.2.3.3, that do not have daylight responsive controls.

TBFA = Total building floor area is the sum of all floor areas included in the lighting power allowance calculation in Section C405.3.2.

Reason: Users need a clear definition of the term general lighting, which is currently used at least 14 times in Section C405, but nowhere else in the code. The term general lighting establishes many of the lighting controls requirements in the code, so it is important that we have a meaning for this term which is clear and concise in all instances.

The current definition of general lighting includes technical requirements, which should not be located there by editorial convention. This proposal would relocate those technical requirements to C405.1, so that they will be applicable throughout Section C405.

Once this definition is updated, redundant provisions of C405.2.3 can be deleted.

The change from “electric” lighting to “general” lighting in the first sentence may be seen as limiting the scope of lighting controls requirements, but it is important that we use consistent terminology throughout this section of the code. Furthermore, we believe that daylight responsive controls requirements should be limited to general lighting. Daylight responsive control of other lighting, such as display and accent lighting, task lighting, lighting in sleeping units, etc. complex and problematic.

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

This proposal would slightly reduce the scope of daylight responsive controls requirements, which would slightly reduce the cost of construction.

Proposal # 4784

CE161-19

CE162-19

IECC: C405.1, C405.1.1 (New), C405.1.2 (New)

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

2018 International Energy Conservation Code

Revise as follows:

C405.1 General (Mandatory). ~~This section covers lighting~~ Lighting system controls, the maximum lighting power for interior and exterior applications and electrical energy consumption shall comply with this section. ~~Dwelling units within multifamily buildings shall comply with Section R404.1. All other dwelling units shall comply with Section R404.1, or with Sections C405.2.4 and C405.3. Sleeping units shall comply with Section C405.2.4, and with Section R404.1 or C405.3. Lighting installed in walk-in coolers, walk-in freezers, refrigerated warehouse coolers and refrigerated warehouse freezers shall comply with the lighting requirements of Section C403.10.1 or C403.10.2.~~

Add new text as follows:

C405.1.1 Lighting for dwelling units. No less than 90 percent of the permanently installed lighting serving dwelling units shall be provided by lamps with an efficacy of not less than 65 lm/W or luminaires with an efficacy of not less than 45 lm/W, or shall comply with Sections C405.2.4 and C405.3.

C405.1.2 Lighting for refrigerated applications. Lighting installed in walk-in coolers, walk-in freezers, refrigerated warehouse coolers and refrigerated warehouse freezers shall comply with the lighting requirements of Section C403.10.1 or C403.10.2.

Reason: The current language refers lighting in dwelling units to the lighting requirements in the residential section. The referenced residential code sections include a requirement that 90% of the lighting be provided by "high efficacy lamps." There are a handful of issues with the existing code requirements:

1. 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. As a result the code has actually become less stringent as the baseline for lighting equipment is raised.
2. The categories in the definition of "high efficacy lamps" in the residential code is an artifact of incandescent and early compact fluorescent lamp wattages. 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 bottom category in the existing definition. As a result, the categories have become largely meaningless.
3. The definition is for high efficacy lamps. However, with the proliferation of LED lighting, the market is increasingly utilizing luminaires with integrated LEDs, which are not really lamps. This prevents this high-efficiency lighting solution from being used to meet the high efficacy requirement.

This proposal solves these problems by replacing the reference to the residential lamp efficacy requirements with built-in lighting requirements. Like the existing lighting requirement, this proposal would require that 90% of the lighting be provided by higher performance lighting, but it replaces the reference to "high efficacy lamps" with a built-in efficacy requirement. This requirement establishes minimums for both lamps and luminaires so that it is relevant to the current lighting market without the wattage bins that are no longer relevant to current technologies. The efficacy levels are widely available and are low enough that products with a wide array of color temperatures and CRIs can meet the requirement, providing lighting designers and customers with flexibility.

The proposal also structures the section for greater clarity. Requirements for dwelling unit lighting and refrigerated application have been somewhat shoe-horned into C405.1, leaving the section bloated and without focus. This proposal breaks the requirements for dwelling unit lighting and refrigerated applications into standalone sub-sections for greater clarity.

When modeled against IECC-2015 using the mid-rise and high-rise prototypes developed by Pacific Northwest National Lab for code determination studies, whole-building energy savings ranged from 0.1-0.5% and whole-building electricity savings ranged from 5.3-6.5%. While the 2018 IECC is not exactly the same baseline as 2015, the lighting requirements did not change and these results give a reasonable approximation of savings. Based on U.S. DOE studies, the cost savings by replacing all of the CFLs with higher efficacy LED lighting saves approximately \$6 per year per dwelling unit in overall regulated energy costs.

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, an 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.

Proposal # 5147

CE162-19

CE163-19

IECC: C202, C405.1, C405.2.1, C405.2.2, C405.2.4, C405.3.1, C405.3.2.2.1

Proponent: Jack Bailey, representing International Association of Lighting Designers (jbailey@oneluxstudio.com); Glenn Heinmiller, Lam Partners, representing International Association of Lighting Designers (glenn@lampartners.com)

2018 International Energy Conservation Code

Revise as follows:

GENERAL LIGHTING. ~~Lighting~~ Interior lighting that provides a substantially uniform level of illumination throughout an area. ~~General lighting shall not include decorative lighting or lighting that provides a dissimilar level of illumination to serve a specialized application or feature within such area.~~ a space.

C405.1 General (Mandatory). This section covers lighting system controls, the maximum lighting power for interior and exterior applications and electrical energy consumption.

Dwelling units within multifamily buildings shall comply with Section R404.1. All other *dwelling units* shall comply with Section R404.1, or with Sections C405.2.4 and C405.3. *Sleeping units* shall comply with Section C405.2.4, and with Section R404.1 or C405.3. Lighting installed in walk-in coolers, walk-in freezers, refrigerated warehouse coolers and refrigerated warehouse freezers shall comply with the lighting requirements of Section C403.10.1 or C403.10.2.

General lighting shall consist of all lighting included when calculating the total connected interior lighting power in accordance with Section C405.3.1 and which does not require specific application controls in accordance with Section C405.2.4.

C405.2.1 Occupant sensor controls. Occupant *sensor controls* shall be installed to control lights in the following space types:

1. Classrooms/lecture/training rooms.
2. Conference/meeting/multipurpose rooms.
3. Copy/print rooms.
4. Lounges/breakrooms.
5. Enclosed offices.
6. Open plan office areas.
7. Restrooms.
8. Storage rooms.
9. Locker rooms.
10. Other spaces 300 square feet (28 m²) or less that are enclosed by floor-to-ceiling height partitions.
11. Warehouse storage areas.

Exception: Luminaires which are required to have specific application controls in accordance with C405.2.4..

C405.2.2 Time-switch controls. Each area of the building that is not provided with *occupant sensor controls* complying with Section C405.2.1.1 shall be provided with *time-switch controls* complying with Section C405.2.2.1.

Exceptions **Exception:**

1. Luminaires which are required to have specific application controls in accordance with

C405.2.4

2. Where a *manual control* provides light reduction in accordance with Section C405.2.2.2, *time-switch controls* shall not be required for the following:

- ~~1-~~ 2.1 Spaces where patient care is directly provided.
- ~~2-~~ 2.2 Spaces where an automatic shutoff would endanger occupant safety or security.
- ~~3-~~ 2.3 Lighting intended for continuous operation.
- ~~4-~~ 2.4 Shop and laboratory classrooms.

C405.2.4 Specific application controls. Specific application controls shall be provided for the following:

1. The following lighting shall be controlled by an occupant sensor complying with Section C405.2.1.1 or a time-switch control complying with Section C405.2.2.1. In addition, a *manual control* shall be provided to control such lighting separately from the *general lighting* in the space:
 - 1.1 Luminaires for which additional lighting power is claimed in accordance with C405.3.2.2.1.
 - ~~1-1-~~ 1.2 Display and accent.
 - ~~1-2-~~ 1.3 Lighting in display cases.
 - ~~1-3-~~ 1.4 Supplemental task lighting, including permanently installed under-shelf or under-cabinet lighting.
 - ~~1-4-~~ 1.5 Lighting equipment that is for sale or demonstration in lighting education.
 - 1.6 Display lighting for exhibits in galleries, museums and monuments that is in addition to *general lighting*.
2. *Sleeping units* shall have control devices or systems that are configured to automatically switch off all permanently installed luminaires and switched receptacles within 20 minutes after all occupants have left the unit.

Exceptions:

1. Lighting and switched receptacles controlled by card key controls.
2. Spaces where patient care is directly provided.
3. Permanently installed luminaires within *dwelling units* shall be provided with controls complying with Section C405.2.1.1 or C405.2.2.2.
4. Lighting for nonvisual applications, such as plant growth and food warming, shall be controlled by a time switch control complying with Section C405.2.2.1 that is independent of the controls for other lighting within the room or space.
5. Task lighting for medical and dental purposes that is in addition to *general lighting* shall be provided with a *manual control*.

C405.3.1 Total connected interior lighting power. The total connected interior lighting power shall be determined in accordance with Equation 4-10.

$$TCLP = [LVL + BLL + LED + TRK + Other]$$

(Equation 4-10)

where:

TCLP = Total connected lighting power (watts).

LVL = For luminaires with lamps connected directly to building power, such as line voltage lamps, the rated

wattage of the lamp.

BLL = For luminaires incorporating a ballast or transformer, the rated input wattage of the ballast or transformer when operating that lamp.

LED = For light-emitting diode luminaires with either integral or remote drivers, the rated wattage of the luminaire.

TRK = For lighting track, cable conductor, rail conductor, and plug-in busway systems that allow the addition and relocation of luminaires without rewiring, the wattage shall be one of the following:

1. The specified wattage of the luminaires, but not less than 8 W per linear foot (25 W/lin m).
2. The wattage limit of the permanent current-limiting devices protecting the system.
3. The wattage limit of the transformer supplying the system.

Other = The wattage of all other luminaires and lighting sources not covered previously and associated with interior lighting verified by data supplied by the manufacturer or other *approved* sources.

The connected power associated with the following lighting equipment and applications is not included in calculating total connected lighting power.

1. Television broadcast lighting for playing areas in sports arenas.
2. Emergency lighting automatically off during normal building operation.
3. Lighting in spaces specifically designed for use by occupants with special lighting needs, including those with visual impairment and other medical and age-related issues.
4. Casino gaming areas.
5. Mirror lighting in dressing rooms.
6. Task lighting for medical and dental purposes that is in addition to *general lighting* ~~and controlled by an independent control device.~~
7. Display lighting for exhibits in galleries, museums and monuments that is in addition to *general lighting* ~~and controlled by an independent control device.~~
8. Lighting for theatrical purposes, including performance, stage, film production and video production.
9. Lighting for photographic processes.
10. Lighting integral to equipment or instrumentation and installed by the manufacturer.
11. Task lighting for plant growth or maintenance.
12. Advertising signage or directional signage.
13. Lighting for food warming.
14. Lighting equipment that is for sale.
15. Lighting demonstration equipment in lighting education facilities.
16. Lighting approved because of safety considerations.
17. Lighting in retail display windows, provided that the display area is enclosed by ceiling-height partitions.
18. Furniture-mounted supplemental task lighting that is controlled by automatic shutoff.
19. Exit signs.

C405.3.2.2.1 Additional interior lighting power. Where using the Space-by-Space Method, an increase in the interior lighting power allowance is permitted for specific lighting functions. Additional power shall be permitted only where the specified lighting is installed and ~~automatically controlled separately from the general lighting, to be turned off during nonbusiness hours.~~ controlled in accordance with C405.2.4. This additional power shall be used only for the specified luminaires and shall not be used for any other purpose. An increase in the interior

lighting power allowance is permitted in the following cases:

1. For lighting equipment to be installed in sales areas specifically to highlight merchandise, the additional lighting power shall be determined in accordance with Equation 4-11. Additional interior lighting power allowance = $1000 \text{ W} + (\text{Retail Area 1} \times 0.45 \text{ W/ft}^2) + (\text{Retail Area 2} \times 0.45 \text{ W/ft}^2) + (\text{Retail Area 3} \times 1.05 \text{ W/ft}^2) + (\text{Retail Area 4} \times 1.87 \text{ W/ft}^2)$
For SI units:

$$\begin{aligned} \text{Additional interior lighting power allowance} = & \\ & 1000 \text{ W} + (\text{Retail Area 1} \times 4.8 \text{ W/m}^2) + \\ & (\text{Retail Area 2} \times 4.84 \text{ W/m}^2) + (\text{Retail Area 3} \\ & \times 11 \text{ W/m}^2) + (\text{Retail Area 4} \times 20 \text{ W/m}^2) \end{aligned}$$

(Equation 4-11)

where:

Retail Area 1 = The floor area for all products not listed in Retail Area 2, 3 or 4.

Retail Area 2 = The floor area used for the sale of vehicles, sporting goods and small electronics.

Retail Area 3 = The floor area used for the sale of furniture, clothing, cosmetics and artwork.

Retail Area 4 = The floor area used for the sale of jewelry, crystal and china.

Exception: Other merchandise categories are permitted to be included in Retail Areas 2 through 4, provided that justification documenting the need for additional lighting power based on visual inspection, contrast, or other critical display is approved by the code official.

2. For spaces in which lighting is specified to be installed in addition to the general lighting for the purpose of decorative appearance or for highlighting art or exhibits, provided that the additional lighting power shall be not more than 0.9 W/ft^2 (9.7 W/m^2) in lobbies and not more than 0.75 W/ft^2 (8.1 W/m^2) in other spaces.

Reason: All lighting controls requirements should be located in C405.2, and all lighting power requirements should be located in C405.3 and C405.4. We should not have lighting control requirements buried in exceptions within C405.3. This proposal consolidates all lighting control requirements in C405.2.

Furthermore, we need a clear definition of the term *general lighting*, which is currently used at least 14 times in Section C405, but nowhere else in the code. The term general lighting establishes many of the lighting controls requirements in the code, so it is important that we have a meaning for this term which is clear and concise in all instances.

The current definition of general lighting includes technical requirements, which should not be located in a definition (by editorial convention). This proposal would relocate those technical requirements to C405.1, so that they will be applicable throughout Section C405.

Do the proposed section references in C405.1 create a circular reference with C405.2.4? No! Consider one example - "task lighting for medical and dental purposes that is in addition to general lighting". There are two ways you could interpret this in a dental exam room:

First, if you wanted to try to game the code and call all lighting in a dental exam room "task lighting for dental purposes" then

1. This lighting cannot be exempt from your power calculations in C405.3.1 (because it is not separate from the

general lighting), and

2. This lighting is not exempt from the controls requirements in C405.2.1 and C405.2.2 (because it is not separate from the general lighting).

However, if you claim only the dental exam light as "task lighting for dental purposes" then

1. The dental exam light is exempt from your lighting power calculations in C405.3 (because it is separate from the general lighting), and

2. The dental exam light is required to be on a separate manual switch (only) by C405.2.4, while the general lighting in the room is required to comply with the automatic control requirements in C405.2.1 and C405.2.2.

A detailed review of the other references to general lighting in C405.2.4 is just as solid (but too tedious to include here!)

The exceptions under C405.2.1 and C405.2.2 are provided for clarity. For example, if you consider "lighting for plant growth", this is specifically required in C405.2.4 to have a time-switch control which is independent of the other lighting controls in the space. But if this lighting were located in an open office area that was required to have occupant sensor control per C405.2.1, then we need to clarify that the occupant sensor required under C405.2.1 does not control the "lighting for plant growth" (because a plant's need for lighting is unrelated to human occupancy in the space).

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

Proposal # 4788

CE163-19

CE164-19

IECC: C405.2.1.2

Proponent: Jonathan McHugh, representing McHugh Energy Consultants Inc. (jon@mchughenergy.com)

2018 International Energy Conservation Code

Revise as follows:

C405.2.1.2 Occupant sensor control function in ~~warehouses~~ warehouse storage areas. Lighting in warehouse storage areas shall be controlled as follows:

1. Lighting in each aisleway shall be controlled independently of lighting in all other aisleways and open areas.
2. Occupant sensors shall automatically reduce lighting power within each controlled area to an unoccupied setpoint of not more than 50 percent of full power within 20 minutes after all occupants have left the controlled area.
3. Lights shall be turned off during scheduled unoccupied periods by: occupant sensors or by time-switch control complying with Section C405.2.2.1.
4. Occupant sensors shall be permitted to automatically turn on lighting upon occupancy within each controlled area. During the occupied schedule period or during times when the manual time switch override is enabled, the time switch control will enable lighting to be controlled by occupant sensors as described in Item 2.
5. Where lighting is also controlled by daylight responsive controls, the controls shall be configured so that the fraction of full power of the lighting shall not exceed the lesser of: the fraction of power allowed by this section and the fraction of power allowed by Section C405.2.3.1.

~~In warehouses, the lighting in aisleways and open areas shall be controlled with occupant sensors that automatically reduce lighting power by not less than 50 percent when the areas are unoccupied. The occupant sensors shall control lighting in each aisleway independently and shall not control lighting beyond the aisleway being controlled by the sensor.~~

Reason: This proposal increases savings. Prior to this change lights could be left on at 50% of power during scheduled unoccupied periods. However the least cost control, an occupancy sensor that turns lights off, does not increase the cost beyond the current code requirements.

There are a number of different alternatives that will also comply and provide partial lighting of unoccupied aisles during occupied hours.

- A partial off occupancy sensing system (dim all the lights or turn at least half the lights off when occupancy is sensed) in conjunction with a timeclock control that turns lights off after hours and reverts to the occupancy control in item 2 during occupied hours or when the timeclock override switch is enabled.
- An occupancy sensing system that receives a time signal and varies the unoccupied light output to partial off during the scheduled occupied period and to full off during the scheduled unoccupied period (unless it is overridden).

Almost all warehouses will have daylit areas due to skylights being prescriptively required by Section C402.4.2 for enclosed spaces larger than 2,500 square feet directly under a roof and with a ceiling height greater than 15 feet. As a result it is desirable to be clear how the required occupancy sensors controls interact with daylight responsive controls. The daylight control requirements in Item 5 of Section C405.2.3.1, "shall be configured to completely shut off all controlled lights." With a 3% prescriptive skylight to floor ratio for half of the warehouse, these spaces will have enough daylight to turn off the lights around half the daylight hours of the year. This proposal specifies that when the two controls interact, the resulting power level is the lesser of the power levels

specified for each control.

Cost Impact: The code change proposal will not increase or decrease the cost of construction
If the occupancy sensing control is turning lights off then there is no cost increase.

If occupancy sensing is not full off then compliance with this proposal will have the relatively small cost of adding a timeclock control.

The rest of the requirements are clarification of how the controls are intended to perform and thus do not add cost.

Proposal # 5600

CE164-19

CE165-19

IECC: C405.2.1.2

Proponent: Jack Bailey, representing International Association of Lighting Designers (jbailey@oneluxstudio.com); Glenn Heinmiller, representing International Association of Lighting Designers (glenn@lampartners.com)

2018 International Energy Conservation Code

Revise as follows:

C405.2.1.2 Occupant sensor control function in ~~warehouses~~ warehouse storage areas. Lighting in warehouse storage areas shall be controlled as follows:

1. Lighting in each aisleway shall be controlled independently of lighting in all other aisleways and open areas.
2. Occupant sensors shall automatically reduce lighting power within each controlled area to an unoccupied setpoint of not more than 50 percent of full power within 20 minutes after all occupants have left the controlled area.
3. Lights which are not turned off by occupant sensors shall be turned off by time-switch control complying with Section C405.2.2.1.
4. Occupant sensors shall be permitted to automatically turn on lighting upon occupancy within each controlled area. Time-switch controls shall not turn lights on to greater than 50 percent of full power.

~~In warehouses, the lighting in aisleways and open areas shall be controlled with occupant sensors that automatically reduce lighting power by not less than 50 percent when the areas are unoccupied. The occupant sensors shall control lighting in each aisleway independently and shall not control lighting beyond the aisleway being controlled by the sensor.~~

Reason: There are some gaps in the current code. Specifically:

1. We should refer to “warehouse storage areas” as this is the relevant space type in Table C405.3.2(2), and this is the space type which is listed in C405.2.1 (the charging language).
2. Current code does not require that lights ever be turned completely off. This proposal would require shutoff by either occupant sensor or time-switch control.
3. Current code does not specify how long it takes for lighting to set back to 50 percent when aisles become unoccupied. This proposal specifies 20 minutes, which conforms to other requirements in the code.
4. Current code does not specify how lights should be turned on. This proposal specifies that automatic-on occupant sensors are permitted, but that time-switch controls (if provided) cannot turn lights on to more than 50%.

We are using the language “to an unoccupied setpoint of not more than 50 percent of full power” for consistency with a separate proposal for Section C405.2.3.1 which clarifies how daylight responsive controls will interact with the partial-off occupancy sensors described here.

There are a variety of ways that people may implement lighting controls to comply with this requirement. At the low end, automatic-on, automatic-off occupant sensors are the cheapest way to comply. These are allowed under current code, and will continue to be allowed if this proposal is approved. At the high end, a time-switch will be used to turn all lights in the warehouse on to 50% (or lower) at the beginning of a shift, and off at the end of a shift. During the shift, occupant sensors will switch the lights from 50% (or lower) when no activity is sensed to 100% when activity is sensed.

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

As outlined above, the least expensive option for complying with current code will continue to be allowed as a strategy to comply with code if this revision is approved.

Proposal # 4794

CE165-19

CE166-19

IECC: C405.2.1.2

Proponent: Marilyn Williams, representing National Electrical Manufacturers Association
(mar_williams@nema.org)

2018 International Energy Conservation Code

Revise as follows:

C405.2.1.2 Occupant sensor control function in warehouses- warehouses storage areas. Lighting in warehouse storage areas shall be controlled as follows:

1. Lighting in each aisleway shall be controlled independently of lighting in all other aisleways and open areas.
2. Occupant sensors shall ~~In warehouses, the lighting in aisleways and open areas shall be controlled with occupant sensors that~~ automatically reduce lighting power within each controlled area by not less than 50 percent within 20 minutes after all occupants have left the controlled area. ~~when the areas are unoccupied. The~~
3. Lights which are not turned off by occupant sensors shall be turned off by time-switch control complying with Section C405.2.2.1. ~~control lighting in each aisleway independently and shall not control lighting beyond the aisleway being controlled by the sensor.~~
4. A manual control shall be provided to allow occupants to turn off lights in the space.

Reason: Revising this language will:

1. Reduce inconsistency and application confusion with warehouse lighting control
2. Reduce energy use (as written could increase energy through interpretation errors)
3. Increase code interpretation
4. Resolve compliance in application, approval and inspection
5. Will not change the intent or requirements of the code provision

The proposal is editorial, and intended to clarify correct application of occupancy sensors, and associated controls for warehouse storage areas. Warehouse spaces were added to the occupancy controls list of space types (C405.2.1) in the 2015 IECC update. Yet, warehouses were excluded from the specific requirements of the main occupancy sensor control functions. Because of this, and the unique control requirements, several elements of how occupancy sensors should operate in the warehouse environment are given no direction or completely left out of the section. This created the following compliance confusion that is resolved with this proposed revision.

1. How long should the area remain unoccupied before lighting would reduce by at least 50% lighting power?
2. How should lighting in warehouses ultimately be turned off?
3. Do manual control devices apply to warehouses or not?

Similar to the enumerated items put into the 2018 IECC version for open office plan spaces, this editorial

change provides clarity to how to apply lighting controls in warehouses storage area spaces. The proposed change clarifies control by item numbers as follows:

1. Item one simplifies language on control independent between aisleways and open areas.
2. Item two language aligns the time delay or "time out" for occupants leaving the warehouse area and turning off or reducing the lighting to 20 minutes. This aligns with the time delay for all other occupancy sensor spaces (C405.2.1.1), newer open plan office spaces (405.2.1.3) and maintains energy efficiency by reducing lighting power.
3. Item three revised language clarifies that the warehouse lighting automatically turns off according to methods already presented in the code (occupancy sensor or time-switch controls) but leaves the decision of automatic shut-off control method to the building design professional.
4. Item four clarifies control is available for the end user to turn lighting off.

Cost Impact: The code change proposal will not increase or decrease the cost of construction. Proposed language is a clarification and editorial in nature. There is no cost impact for implementation and increases energy efficiency through reducing confusion and increasing compliance.

Proposal # 4372

CE166-19

CE167-19

IECC: C405.2.1.1

Proponent: Jack Bailey, representing International Association of Lighting Designers (jbailey@oneluxstudio.com); Glenn Heinmiller, Lam Partners, representing International Association of Lighting Designers (glenn@lampartners.com)

2018 International Energy Conservation Code

Revise as follows:

C405.2.1.1 Occupant sensor control function. Occupant sensor controls in warehouses shall comply with Section C405.2.1.2. Occupant sensor controls in open plan office areas shall comply with Section C405.2.1.3. Occupant sensor controls for all other spaces specified in Section C405.2.1 shall comply with the following:

1. They shall automatically turn off lights within 20 minutes after all occupants have left the space.
2. They shall be manual on or controlled to automatically turn on the lighting to not more than 50-percent power.
3. They shall incorporate a manual control to allow occupants to turn off lights.

Exception: Full automatic-on controls with no manual control shall be permitted to control lighting in public corridors, interior parking areas, stairways, restrooms, ~~primary building entrance areas and lobbies, locker rooms, lobbies, library stacks,~~ and areas where manual operation would endanger the safety or security of the room or building occupants. ~~3. They shall incorporate a manual control to allow occupants to turn off lights.~~ occupant safety or security.

Reason: The code currently requires that *readily accessible* manual controls be provided to allow occupants to turn the lights off in the space types listed in this exception. We don't believe this should be required by the code, because the occupant sensors will already turn the lights off when no occupants are present, meaning that the accessible manual control would only be used to turn off lights when occupants are present. This could compromise safety for building occupants in these types of spaces.

We have changed the terminology "primary building entrance areas and lobbies" to read "lobbies" because we believe that all space types listed in this section of the code should be correlated with the space-by-space LPD table C405.3.2(2).

The safety and security language that is currently in this section of the code is a bit odd. The language proposed here, "areas where manual operation would endanger occupant safety or security" matches the language in C405.2.2 exception 2.

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

This proposal will reduce the cost of construction by eliminating the requirement for a manual control device in the indicated space types. We anticipate only a minimal impact on energy efficiency because we expect these manual controls are rarely used.

Proposal # 4837

CE167-19

CE168-19

IECC: C405.2.1, C405.2.1.1, C405.2.1.2

Proponent: Marilyn Williams, representing National Electrical Manufacturers Association
(mar_williams@nema.org)

2018 International Energy Conservation Code

Revise as follows:

C405.2.1 Occupant sensor controls. Occupant *sensor controls* shall be installed to control lights in the following space types complying with Sections C405.2.1.1, C405.2.1.2, and C405.2.1.3:

1. ~~Classrooms/lecture/training rooms.~~
2. ~~Conference/meeting/multipurpose rooms.~~
3. ~~Copy/print rooms.~~
4. ~~Lounges/breakrooms.~~
5. ~~Enclosed offices.~~
6. ~~Open plan office areas.~~
7. ~~Restrooms.~~
8. ~~Storage rooms.~~
9. ~~Locker rooms.~~
10. ~~Other spaces 300 square feet (28 m²) or less that are enclosed by floor-to-ceiling height partitions.~~
11. ~~Warehouse storage areas.~~

C405.2.1.1 Occupant sensor control function in automatic-full-off spaces. ~~Occupant sensor controls in warehouses shall comply with Section C405.2.1.2. Occupant sensor controls in open plan office areas shall comply with Section C405.2.1.3. Occupant sensor controls for all other spaces specified in Section C405.2.1 shall comply with the following:~~

Lighting in these space types shall be controlled as follows:

Classrooms/lecture/training rooms.

Conference/meeting/multipurpose rooms.

Copy/print rooms.

Lounges/breakrooms.

Enclosed offices.

Restrooms.

Storage rooms 1000 square feet (90 m²) or less that are enclosed by floor-to-ceiling height partitions.

Locker rooms.

Other spaces 300 square feed (28 m²) or less that are enclosed by floor-to-ceiling height partitions.

1. ~~They shall automatically turn off lights~~ Lighting shall automatically turn off within 20 minutes after

- all occupants have left the space.
2. ~~They~~ Lighting shall be manual on or controlled to automatically turn on ~~the lighting~~ to not more than 50-percent power.

Exception: Full automatic-on controls shall be permitted to control lighting in ~~public corridors, stairways, restrooms, primary building entrance areas and lobbies, and areas~~ where manual-on operation would endanger the safety or security of the room or building occupants..

3. ~~They shall incorporate a~~ A manual control shall be provided to allow occupants to turn off lights in the space.

C405.2.1.2 Occupant sensor control function in ~~warehouses~~ automatic-partial-off spaces. Lighting in these space types shall be controlled as follows:

Warehouse storage areas.

Storage rooms greater than 1000 square feet (90 m²) that are enclosed by floor-to-ceiling height partitions.

Classroom labs.

Corridors.

1. Lighting shall ~~In warehouses, the lighting in aisleways and open areas shall be controlled with occupant sensors that~~ automatically reduce lighting power within each controlled area by not less than 50 percent ~~when the areas are unoccupied. The~~ within 20 minutes after all occupants have left the controlled area.
2. Lights which are not turned off by occupant sensors shall be turned off by time-switch control complying with Section C405.2.21.
3. A manual control shall be provided to allow occupants to turn off lights in the space.
4. In warehouse storage areas, lighting in each aisleway shall be controlled independently and shall not control lighting beyond the aisleway being controlled by the sensor. of lighting in all other aisleways and open areas.

Exception: Spaces where the lighting power is 150 Watts or less.

Reason: Revising this language will:

1. Increase energy efficiency in buildings
2. Reduce inconsistency and application confusion with warehouse lighting control.
3. Increase code interpretation and usability
4. Resolve compliance in application, approval and inspection.

see attachment for further information for reason

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

The cost impact for added controls only applies to storage rooms greater than 1000 square feet, library stacks, classroom labs, and corridors. There will be no cost impact to warehouse storage areas or other space types as the revision is an editorial clarification for those spaces.

CE169-19

IECC: C405.2.1, C405.2.1.1, C405.2.1.4(New)

Proponent: Jack Bailey, representing International Association of Lighting Designers (jbailey@oneluxstudio.com); Glenn Heinmiller, Lam Partners, representing International Association of Lighting Designers (glenn@lampartners.com)

2018 International Energy Conservation Code

Revise as follows:

C405.2.1 Occupant sensor controls. Occupant *sensor controls* shall be installed to control lights in the following space types:

1. Classrooms/lecture/training rooms.
2. Conference/meeting/multipurpose rooms.
3. Copy/print rooms.
4. Lounges/breakrooms.
5. Enclosed offices.
6. Open plan office areas.
7. Restrooms.
8. Storage rooms.
9. Locker rooms.
10. Corridors
11. Warehouse storage areas
- 12.~~10.~~ Other spaces 300 square feet (28 m²) or less that are enclosed by floor-to-ceiling height partitions.

C405.2.1.1 Occupant sensor control function. Occupant sensor controls in warehouses shall comply with Section C405.2.1.2. Occupant sensor controls in open plan office areas shall comply with Section C405.2.1.3. Occupant sensor controls in corridors shall comply with Section C405.2.1.4. Occupant sensor controls for all other spaces specified in Section C405.2.1 shall comply with the following:

1. They shall automatically turn off lights within 20 minutes after all occupants have left the space.
2. They shall be manual on or controlled to automatically turn on the lighting to not more than 50-percent power.

Exception: Full automatic-on controls shall be permitted to control lighting in ~~public corridors~~, stairways, restrooms, primary building entrance areas and lobbies, and areas where manual-on operation would endanger the safety or security of the room or building occupants.

3. They shall incorporate a manual control to allow occupants to turn off lights.

Add new text as follows:

C405.2.1.4 Occupant sensor control function in corridors Occupant sensor controls in corridors shall uniformly reduce lighting power to not more than 50 percent of full power within 20 minutes after all occupants have left the space.

Exception: Corridors provided with less than two foot-candles of illumination on the floor at the darkest point with all lights on.

Reason: To save energy. Current code requires that occupant sensors be installed in any corridor which is smaller than 300 square feet (60 feet long for a 5 foot wide corridor). These will usually be automatic-on, automatic-off occupant sensors with manual override switch. C405.2 exception 2 exempts corridors which are *exit passageways* (see IBC) are exempt.

There should be one uniform requirement for occupant sensor control of lights in corridors regardless of whether they are smaller than 300 square feet, and we propose that this requirement should allow for lights to remain continuously “on” at a reduced level to alleviate safety concerns about people entering dark corridors before the lights will turn on.

By allowing corridor lighting to remain “on” at 50% when unoccupied, this proposal will also avoid most potential conflicts with the IBC, which requires that lighting in a corridor be maintained at a minimum of 1 foot-candle (at the darkest point) whenever spaces served by the corridor are occupied. An exception is also provided for corridors with less than 2 foot-candles of illumination at the darkest point when all lights are on, so that we are not requiring controls in darker corridors where there will be no opportunity for light reduction. The majority of corridors are lighted to > 2 fc minimum, so occupancy sensors will still be widely required in corridors.

This proposal is technology-neutral, in that it requires a 50% reduction in lighting power, but does not specify whether this is achieved by switching alternate fixtures, or by uniformly dimming all fixtures.

Cost Impact: The code change proposal will increase the cost of construction. Construction costs will be increased in projects which are required to add occupant sensors (i.e. those with corridors greater than 300 sf).

At 0.66 watts/sf (see C405.3.2(2)) a >300 sf corridor will have >200 watts of lighting installed. A 50% reduction would be >100 watt when lights are set back. Assuming 20 hours/day of light reduction (corridors are infrequently occupied), this yields a savings of at least 730 kwh/year (\$77.82 per year at the national average rate of \$0.1066/kwh).

See https://www.eia.gov/electricity/annual/html/epa/_02_07.html for national average cost of electricity.

A 60 foot corridor can be controlled from one \$80 occupant sensor. Even with installation and wiring costs added in, this will have an attractive payback.

Proposal # 4776

CE169-19

CE170-19

IECC: C405.2.1.3, C405.2.3.1

Proponent: Jack Bailey, representing International Association of Lighting Designers (jbailey@oneluxstudio.com); Glenn Heinmiller, Lam Partners, representing International Association of Lighting Designers (glenn@lampartners.com)

2018 International Energy Conservation Code

Revise as follows:

C405.2.1.3 Occupant sensor control function in open plan office areas. Occupant sensor controls in open plan office spaces less than 300 square feet (28 m²) in area shall comply with Section C405.2.1.1. Occupant sensor controls in all other open plan office spaces shall comply with all of the following:

1. The controls shall be configured so that general lighting can be controlled separately in control zones with floor areas not greater than 600 square feet (55 m²) within the open plan office space.
2. The controls shall automatically turn off general lighting in all control zones within 20 minutes after all occupants have left the open plan office space.
3. The controls shall be configured so that general lighting power in each control zone is reduced by not less than 80 percent of the full zone general lighting power in a reasonably uniform illumination pattern within 20 minutes of all occupants leaving that control zone. Control functions that switch control zone lights completely off when the zone is vacant meet this requirement.
4. ~~The controls shall be configured such that any daylight responsive control will activate open plan office space general lighting or control zone general lighting only when occupancy for the same area is detected.~~

C405.2.3.1 Daylight-responsive control function. Where required, daylight-responsive controls shall be provided within each space for control of lights in that space and shall comply with all of the following:

1. Lights in toplit zones in accordance with Section C405.2.3.3 shall be controlled independently of lights in sidelit zones in accordance with Section C405.2.3.2.
2. Daylight responsive controls within each space shall be configured so that they can be calibrated from within that space by authorized personnel.
3. Calibration mechanisms shall be in a location with ready access.
4. Where located in offices, classrooms, laboratories and library reading rooms, daylight responsive controls shall dim lights continuously from full light output to 15 percent of full light output or lower.
5. Daylight responsive controls shall be configured to completely shut off all controlled lights.
6. When occupant sensor controls have reduced the lighting power to an unoccupied setpoint in accordance with Sections C405.2.1.2 through C405.2.1.4, daylight responsive controls shall continue to adjust electric light levels in response to available daylight, but shall be configured to not increase the lighting power above the specified unoccupied setpoint.
7. Lights in sidelit zones in accordance with Section C405.2.3.2 facing different cardinal orientations [within 45 degrees (0.79 rad) of due north, east, south, west] shall be controlled independently of each other.

Exception: Up to 150 watts of lighting in each space is permitted to be controlled together with lighting in a daylight zone facing a different cardinal orientation.

Reason: The code allows “partial-off” occupant sensors in warehouses and open office areas. A separate

proposal being heard in this cycle would also require that partial-off occupant sensors be provided in corridors (although few corridors have >150W of lighting within a daylight zone).

For lights which will be controlled by both partial-off occupant sensors and daylight responsive controls, it is important that both controls work together to achieve maximum energy savings. Specifically that:

1. Daylight responsive controls continue to reduce light levels in response to daylight in spaces which are unoccupied.
2. Daylight responsive controls do not increase light levels above the unoccupied setpoint (either 50% or 20% depending on the space type) in spaces which are unoccupied.

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

Since “partial-off” occupant sensors are not required for warehouses and open office areas (auto-off is the cheaper way to comply with code), there is no added cost or complexity here for the code-minimum controls solution.

Proposal # 4989

CE170-19

CE171-19

IECC: C405.2.1.3

Proponent: Jack Bailey, representing International Association of Lighting Designers (jbailey@oneluxstudio.com); Glenn Heinmiller, Lam Partners, representing International Association of Lighting Designers (glenn@lampartners.com)

2018 International Energy Conservation Code

Revise as follows:

C405.2.1.3 Occupant sensor control function in open plan office areas. Occupant sensor controls in open plan office spaces less than 300 square feet (28 m²) in area shall comply with Section C405.2.1.1. Occupant sensor controls in all other open plan office spaces shall comply with all of the following:

1. The controls shall be configured so that *general lighting* can be controlled separately in control zones with floor areas not greater than 600 square feet (55 m²) within the open plan office space.
2. General lighting in each control zone shall be permitted to automatically turn on upon occupancy within the control zone. General lighting in other unoccupied zones within the open plan office space shall be permitted to turn on to no more than 20 percent of full power or remain unaffected.
- ~~2-3.~~ The controls shall automatically turn off *general lighting* in all control zones within 20 minutes after all occupants have left the open plan office space.
- ~~3.~~ ~~The controls shall be configured so that general lighting power.~~
4. General lighting in each control zone is reduced by not less than 80 percent of the full zone general lighting power in a reasonably uniform illumination pattern within 20 minutes of all occupants leaving that control zone. Control functions that switch control zone lights completely off when the zone is vacant meet this requirement. shall turn off or uniformly reduce lighting power to an unoccupied setpoint of not more than 20 percent of full power within 20 minutes after all occupants have left the control zone.
- ~~4-5.~~ The controls shall be configured such that any daylight responsive control will activate open plan office space general lighting or control zone general lighting only when occupancy for the same area is detected.

Reason: The code is silent about how lights are to be turned on in open office areas. Since the “on” function in occupant sensors is something that we are usually quite concerned with in the code, this silence is unusual, and users of the code will make their own (different) assumptions about how to interpret this silence. The addition of new item 2 above clarifies this.

Revision of item 4 is editorial in nature, and intended to conform the language in this section more closely with other code provisions related to occupant sensors. The language “to an unoccupied setpoint of not more than 20 percent of full power” is for consistency with a separate proposal for Section C405.2.3.1 which clarifies how daylight responsive controls will interact with the partial-off occupancy sensors described here. Regardless of whether that separate proposal is approved, this language still makes sense and describes the intended result.

Cost Impact: The code change proposal will not increase or decrease the cost of construction. These changes reduce the potential for confusion and inconsistency in application of the code.

Proposal # 4774

CE171-19

CE172-19

IECC: C405.2.1.3

Proponent: Jack Bailey, representing International Association of Lighting Designers (jbailey@oneluxstudio.com); Glenn Heinmiller, representing International Association of Lighting Designers (glenn@lampartners.com)

2018 International Energy Conservation Code

Revise as follows:

C405.2.1.3 Occupant sensor control function in open plan office areas. Occupant sensor controls in open plan office spaces less than 300 square feet (28 m²) in area shall comply with Section C405.2.1.1. Occupant sensor controls in all other open plan office spaces shall comply with all of the following:

1. The controls shall be configured so that general lighting can be controlled separately in control zones with floor areas not greater than 600 square feet (55 m²) within the open plan office space.
Exception: Where general lighting is turned off by time-switch control complying with Section C405.2.2.1
2. The controls shall automatically turn off general lighting in all control zones within 20 minutes after all occupants have left the open plan office space.
3. The controls shall be configured so that general lighting power in each control zone is reduced by not less than 80 percent of the full zone general lighting power in a reasonably uniform illumination pattern within 20 minutes of all occupants leaving that control zone. Control functions that switch control zone lights completely off when the zone is vacant meet this requirement.
4. The controls shall be configured such that any daylight responsive control will activate open plan office space general lighting or control zone general lighting only when occupancy for the same area is detected.

Reason: Private offices are often configured so that occupants need to pass through open office areas to get to restrooms, printers, pantries, etc. and to exit the building. When an occupant in a private office works later than the last occupant of the open office space, they will find the lights have been set back or turned off by the occupant sensors in the open office area that they need to pass through. This is not necessarily a safety or security issue, because there will likely be some night lighting, and lights can be turned on for safe passage through the space, but it does create a perception issue. If you are the person working in the private office when the rest of the lights shut off, you may feel like (a) it is unsafe to remain, or (b) you have worked too late and it is time to go home. Some organizations won't like this.

The reason why the code currently allows lights in unoccupied areas of an open office to remain on at a reduced level is to that the last person working late in the open office area does not feel like they are all alone in a pool of light in the middle of a dark room. The proposed change would apply the same reasoning for the last person working late in a private office. The situation is very similar, and especially if the private office has a glass office front.

It is possible to achieve this same result with networked lighting controls that tie private office occupant sensors together with open office occupant sensors, but this is quite expensive. Achieving this with time scheduling results in reduced energy savings, but also reduced first cost and less controls complexity

Cost Impact: The code change proposal will not increase or decrease the cost of construction. This exception allows more flexibility, but does not alter the lowest-cost path of compliance (which remains automatic-on, automatic-off occupant sensors).

CE173-19

IECC: C405.2.1.3

Proponent: Jonathan McHugh, representing McHugh Energy Consultants Inc. (jon@mchughenergy.com)

2018 International Energy Conservation Code

Revise as follows:

C405.2.1.3 Occupant sensor control function in open plan office areas. Occupant sensor controls in open plan office spaces less than 300 square feet (28 m²) in area shall comply with Section C405.2.1.1. Occupant sensor controls in all other open plan office spaces shall comply with all of the following:

1. The controls shall be configured so that general lighting can be controlled separately in control zones with floor areas not greater than 600 square feet (55 m²) within the open plan office space.
2. General lighting in each control zone shall be allowed to automatically turn on upon occupancy within the control zone. General lighting in other unoccupied zones within the open plan office space shall be allowed to turn on to no more than 20 percent of full power or remain unaffected.
3. The controls shall automatically turn off general lighting in all control zones within 20 minutes after all occupants have left the open plan office space. Controls shall automatically return lighting to their previous settings if occupancy is detected within 30 seconds of lights being turned off.
4. General lighting in each control zone shall turn off or uniformly reduce lighting power to no more than 20 percent of full power within 20 minutes after all occupants have left the
3. ~~The controls shall be configured so that general lighting power in each control zone is reduced by not less than 80 percent of the full zone general lighting power in a reasonably uniform illumination pattern within 20 minutes of all occupants leaving that control zone. Control functions that switch control zone lights completely off when the zone is vacant meet this requirement.~~
- 4-5. The For general lighting also served by daylight responsive controls as required by Section C405.2.3, the occupant sensor control and the daylight responsive controls shall be configured such that any daylight responsive control will activate open plan office space general lighting or control zone general lighting only when occupancy for the same area is detected, so that power does not exceed the lesser of: the allowed power in Section C405.2.3.1 and the allowed power in Items 2 through 4 of this section.

Reason:

Item 2 clarifies what happen when occupancy is detected.

Revision of item 3 addresses the concern that lights are turned completely off and manual-on sensors are used, this could be a safety issue as the last occupant either walks through a dark open office area or must find switches to turn the lights on. This proposal will address this safety issue with the specification that manual on control function is overridden to automatic on if the motion is sensed within 30 seconds of lights being turned off. This capability can be accomplished with networked controls and also simpler controls.

Item 5 clarifies that luminaires controlled by both occupancy sensors and daylight responsive controls are controlled to the lower power level of the two controls.

Cost Impact: The code change proposal will not increase or decrease the cost of construction
This proposal has not effect on cost. This proposal clarifies the existing language.

CE174-19

IECC: C405.2, C405.2.2, C405.2.2.1, C405.2.2.2, C405.2.3, C405.2.3.1

Proponent: Marilyn Williams, representing National Electrical Manufacturers Association
(mar_williams@nema.org)

2018 International Energy Conservation Code

Revise as follows:

C405.2 Lighting controls (Mandatory). Lighting systems shall be provided with controls that comply with one of the following.

1. Lighting controls as specified in Sections C405.2.1 through ~~C405.2.6~~ C405.2.7.
2. Luminaire level lighting controls (LLLC) and lighting controls as specified in Sections C405.2.1, ~~C405.2.4~~ C405.2.3, C405.2.5 and ~~C405.2.5~~ C405.2.6. The LLLC luminaire shall be independently capable of:
 - 2.1. Monitoring occupant activity to brighten or dim lighting when occupied or unoccupied, respectively.
 - 2.2. Monitoring ambient light, both electric light and daylight, and brighten or dim artificial light to maintain desired light level.
 - 2.3. For each control strategy, configuration and reconfiguration of performance parameters including; bright and dim setpoints, timeouts, dimming fade rates, sensor sensitivity adjustments, and wireless zoning configurations.

Exceptions: Lighting controls are not required for the following:

1. Areas designated as security or emergency areas that are required to be continuously lighted.
2. Interior exit stairways, interior exit ramps and exit passageways.
3. Emergency egress lighting that is normally off.

C405.2.2 Time-switch controls. Each area of the building that is not provided with *occupant sensor controls* complying with Section C405.2.1.1 shall be provided with *time-switch controls* complying with Section C405.2.2.1.

Exception: ~~Where a manual control provides light reduction in accordance with Section C405.2.2.2, time-switch controls shall not be required for the following:~~

1. Spaces where patient care is directly provided.
2. Spaces where an automatic shutoff would endanger occupant safety or security.
3. Lighting intended for continuous operation.
4. Shop and laboratory classrooms.

C405.2.2.1 Time-switch control function. ~~Each space provided with time-switch controls shall be provided with a manual control for light reduction in accordance with Section C405.2.2.2. Time-switch controls shall include~~ incorporate an override switching device that complies with the following:

1. Have a minimum 7-day clock.
2. Be capable of being set for seven different day types per week.
3. Incorporate an automatic holiday "shutoff" feature, which turns off all controlled lighting loads for

- not fewer than 24 hours and then resumes normally scheduled operations.
- 4. Have program backup capabilities, which prevent the loss of program and time settings for not fewer than 10 hours, if power is interrupted.
- 5. Include an override switch that complies with the following:
 - 5.1. The override switch shall be a manual control.
 - 5.2. The override switch, when initiated, shall permit the controlled lighting to remain on for not more than 2 hours.
 - 5.3. Any individual override switch shall control the lighting for an area not larger than 5,000 square feet (465 m²).

Exceptions:

- 1. Within mall concourses, auditoriums, sales areas, manufacturing facilities and sports arenas:
 - 1.1. The time limit shall be permitted to be greater than 2 hours, provided that the switch is a captive key device..
 - 1.2. The area controlled by the override switch shall not be limited to 5,000 square feet (465 m²) provided that such area is less than 20,000 square feet (1860 m²).
- 2. ~~Where provided with manual control, the following areas are not required to have light reduction control:~~
 - 2.1. ~~Spaces that have only one luminaire with a rated power of less than 100 watts.~~
 - 2.2. ~~Spaces that use less than 0.6 watts per square foot (6.5 W/ m²).~~
 - 2.3. ~~Corridors, lobbies, electrical rooms and or mechanical rooms.~~

~~C405.2.2.2 Light-reduction controls.~~ ~~Spaces required to have light reduction controls shall have a manual control that allows the occupant to reduce the connected lighting load in a reasonably uniform illumination pattern by not less than 50 percent. Lighting reduction shall be achieved by one of the following or another approved method:~~

- ~~1. Controlling all lamps or luminaires.~~
- ~~2. Dual switching of alternate rows of luminaires, alternate luminaires or alternate lamps.~~
- ~~3. Switching the middle lamp luminaires independently of the outer lamps.~~
- ~~4. Switching each luminaire or each lamp.~~

~~Exception:~~ ~~Light reduction controls are not required in daylight zones with daylight responsive controls complying with Section C405.2.3.~~

C405.2.3 Daylight-responsive controls. Each area of the building shall have light reduction controls complying with Section C405.2.3.1. ~~shall be provided to control the electric lights within daylight zones in the following spaces~~

Exceptions: Where provided with manual control, the following areas are not required to have light reduction control:

- 1. Spaces that have only one luminaire with a total rated power of less than 100 watts.
- 2. Spaces that use less than 0.6 watts per square foot (6.5 W/m²).
- 3. Corridors, lobbies, electrical rooms and or mechanical rooms.
- 4. Daylight zones with daylight responsive controls complying with Section C405.2.4 more than 150 watts of general lighting within sidelit zones complying with Section C405.2.3.2 General

~~lighting does not include lighting that is required to have specific application control in accordance with Section C405.2.4. 2. Spaces with a total of more than 150 watts of general lighting within toplit zones complying with Section C405.2.3.3.~~

Exceptions: Daylight responsive controls are not required for the following:

1. Spaces in health care facilities where patient care is directly provided.
2. Lighting that is required to have specific application control in accordance with Section C405.2.4.
3. Sidelit zones on the first floor above grade in Group A-2 and Group M occupancies.
4. New buildings where the total connected lighting power calculated in accordance with Section C405.3.1 is not greater than the adjusted interior lighting power allowance (LPA_{adj}) calculated in accordance with Equation 4-9

$$LPA_{adj} = \left[\frac{LPA_{norm} \times (1.0 - 0.4 \times UDZFA)}{TBFA} \right]$$

(Equation 4-9)

where:

LPA_{adj} = Adjusted building interior lighting power allowance in watts.

LPA_{norm} = Normal building lighting power allowance in watts calculated in accordance with Section C405.3.2 and reduced in accordance with Section C406.3 where Option 2 of Section C406.1 is used to comply with the requirements of Section C406.

$UDZFA$ = Uncontrolled daylight zone floor area is the sum of all sidelit and toplit zones, calculated in accordance with Sections C405.2.3.2 and C405.2.3.3, that do not have daylight responsive controls.

$TBFA$ = Total building floor area is the sum of all floor areas included in the lighting power allowance calculation in Section C405.3.2.

C405.2.3.1 Daylight-responsive Light-reduction control function. Light-reduction controls shall have a manual control that allows the occupant to turn the lights completely off, and to an intermediate step that reduces the connected lighting load by not less than 50 percent. Lighting reduction shall be achieved by one of the following or another approved method:

1. Controlling all lamps or luminaires.
2. Dual switching of alternate rows of luminaires, alternate luminaires or alternate lamps.
3. Switching the middle lamp luminaires independently of the outer lamps.
4. Switching each luminaire or each lamp.

Where required, *daylight-responsive controls* shall be provided within each space for control of lights in that space and shall comply with all of the following:

1. Lights in *toplit zones* in accordance with Section C405.2.3.3 shall be controlled independently of lights in sidelit zones in accordance with Section C405.2.3.2.
2. *Daylight responsive controls* within each space shall be configured so that they can be calibrated from within that space by authorized personnel.
3. Calibration mechanisms shall be in a location with *ready access*.
4. Where located in offices, classrooms, laboratories and library reading rooms, *daylight responsive controls* shall dim lights continuously from full light output to 15 percent of full light

output or lower.

5. *Daylight responsive controls* shall be configured to completely shut off all controlled lights.
6. Lights in *sidelit zones* in accordance with Section C405.2.3.2 facing different cardinal orientations [within 45 degrees (0.79 rad) of due north, east, south, west] shall be controlled independently of each other.

Exception: Up to 150 watts of lighting in each space is permitted to be controlled together with lighting in a daylight zone facing a different cardinal orientation.

Reason: Revising this language will:

1. Reduce inconsistency and confusion with light-reduction control requirements
2. Reduce energy use
3. Increase code interpretation simplicity
4. Resolve compliance in application, approval and inspection
5. Improve the occupant's ability to operate their lighting
6. Will not change the intent or requirements of the code provision.

Beginning with the 2015 IECC, light reduction controls has been a significant area of confusion in the lighting control section. Much of this is founded in the editing from the 2012 IECC to the 2015 IECC. As an example, some of the exceptions to light reduction control are found in the C405.2.2.1 Time-switch control function section. This proposed change puts these exceptions under the light reduction control section, instead of the Time-switch control function section. This will simplify reading and interpretation of the code, as one would not expect to find code provision exceptions residing in a different section.

The proposal simplifies code language by eliminating confusing and redundant pre-condition phrases in the exceptions to C405.2.2 Time-switch control, and C405.2.2.1 Time-switch control function, by removing "in accordance with Section C405.2.2.2 Light reduction control".

Removing the light reduction control from being a subsection of C405.2.2 Time-switch controls, into its own section C405.2.3, as was done with the C405.2.5 Manual Controls section in the 2018 IECC cycle, will help clarify ambiguity within the electrical and lighting design community. Some interpret that the light reduction control requirements only apply to spaces where the lighting shut-off is accomplished through time-switch control. Some jurisdictions, like the City of Houston, have written clarifying position statements to overcome the confusion with how this code section is written. The verbal interpretation given by the ICC technical support line has supported the interpretation that light reduction control applies to all spaces, regardless of lighting shut-off method, and regardless of its sub-paragraphing under the time-switch control provision.

The proposal applies light reduction control for good occupant controllability of lighting in the space and for increased energy efficiency to all buildings spaces not listed in the exceptions.

This would align the IECC with other energy efficiency codes and reduce the significant application and inspection confusion that currently exists with how this provision is written.

Cost Impact: The code change proposal will increase the cost of construction
Baselining the cost of construction at where light reduction control is applicable to all spaces, except spaces where exempt, the cost remains the same as current code and the energy efficiency benefits remain the same.

Proposal # 4382

CE174-19

CE175-19

IECC: C405.2, C405.2.2, C405.2.2.1, C405.2.2.2, C405.2.3.1, C405.2.3(New), C405.2.4, C405.2.3, C405.2.5

Proponent: Jack Bailey, representing International Association of Lighting Designers (jbailey@oneluxstudio.com); Glenn Heinmiller, Lam Partners, representing International Association of Lighting Designers (glenn@lampartners.com)

2018 International Energy Conservation Code

Revise as follows:

C405.2 Lighting controls (Mandatory). Lighting systems shall be provided with controls that comply with one of the following.

1. Lighting controls as specified in Sections C405.2.1 through ~~C405.2.6~~ C405.2.7.
2. Luminaire level lighting controls (LLLC) and lighting controls as specified in Sections C405.2.1, ~~C405.2.4~~ C405.2.5 and ~~C405.2.5~~ C405.2.6. The LLLC luminaire shall be independently capable of:
 - 2.1. Monitoring occupant activity to brighten or dim lighting when occupied or unoccupied, respectively.
 - 2.2. Monitoring ambient light, both electric light and daylight, and brighten or dim artificial light to maintain desired light level.
 - 2.3. For each control strategy, configuration and reconfiguration of performance parameters including; bright and dim setpoints, timeouts, dimming fade rates, sensor sensitivity adjustments, and wireless zoning configurations.

Exceptions: Lighting controls are not required for the following:

1. Areas designated as security or emergency areas that are required to be continuously lighted.
2. Interior exit stairways, interior exit ramps and exit passageways.
3. Emergency egress lighting that is normally off.

C405.2.2 Time-switch controls. Each area of the building that is not provided with *occupant sensor controls* complying with Section C405.2.1.1 shall be provided with *time-switch controls* complying with Section C405.2.2.1.

Exception ~~Exceptions:~~ ~~Where a manual control provides light reduction in accordance with Section C405.2.2.2, time-switch controls shall not be required for the following:~~

1. Spaces where patient care is directly provided.
2. Spaces where an automatic shutoff would endanger occupant safety or security.
3. Lighting intended for continuous operation.
4. Shop and laboratory classrooms.

C405.2.2.1 Time-switch control function. ~~Each space provided with time-switch controls shall be provided with a manual control for light reduction in accordance with Section C405.2.2.2. Time-switch controls shall include an override switching device that complies with~~ comply with the all of the following:

1. Automatically turn lights off when the space is scheduled to be unoccupied.
2. Have a minimum 7-day clock.

3. Be capable of being set for seven different day types per week.
4. Incorporate an automatic holiday "shutoff" feature, which turns off all controlled lighting loads for not fewer than 24 hours and then resumes normally scheduled operations.
5. Have program backup capabilities, which prevent the loss of program and time settings for not fewer than 10 hours, if power is interrupted.
6. Include an override switch that complies with the following:
 - 6.1. The override switch shall be a manual control.
 - 6.2. The override switch, when initiated, shall permit the controlled lighting to remain on for not more than 2 hours.
 - 6.3.. Any individual override switch shall control the lighting for an area not larger than 5,000 square feet (465 m²).

Exception Exceptions:

1. Within mall concourses, auditoriums, sales areas, manufacturing facilities and sports arenas:
 - 1.1. The time limit shall be permitted to be greater than 2 hours, provided that the switch is a captive key device.
 - 1.2. The area controlled by the override switch shall not be limited to 5,000 square feet (465 m²) provided that such area is less than 20,000 square feet (1860m²).
2. ~~Where provided with *manual control*, the following areas are not required to have light reduction control:~~
 - 2.1. ~~Spaces that have only one luminaire with a rated power of less than 100 watts.~~
 - 2.2. ~~Spaces that use less than 0.6 watts per square foot (6.5 W/m²).~~
 - 2.3. ~~Corridors, lobbies, electrical rooms and or mechanical rooms.~~

C405.2.2.2 C405.2.3.1 Light-reduction controls, control function. Spaces required to have light-reduction controls shall have a *manual control* that allows the occupant to reduce the connected lighting load in a reasonably uniform illumination pattern by not less than 50 percent. Lighting reduction shall be achieved by one of the following or another *approved* method:

1. Controlling all lamps or luminaires.
2. Dual switching of alternate rows of luminaires, alternate luminaires or alternate lamps.
3. Switching the middle lamp luminaires independently of the outer lamps.
4. Switching each luminaire or each lamp.

Exception: ~~Light reduction controls are not required in *daylight zones* with *daylight responsive controls* complying with Section C405.2.3.~~

Add new text as follows:

405.2.3 Light reduction controls Where not provided with occupant sensor controls complying with Section C405.2.1.1, *general lighting* shall be provided with light reduction controls complying with C405.2.3.1.

Exceptions:

1. Luminaires controlled by daylight responsive controls complying with C405.2.4.

2. Luminaires controlled by special application controls complying with C405.2.5.
3. Where provided with manual control, the following areas are not required to have light reduction control::
 - 3.1. Spaces that have only one luminaire with a rated power of less than 100 watts.
 - 3.2. Spaces that use less than 0.6 watts per square foot (6.5 W/m².)
 - 3.3. Corridors, lobbies, electrical rooms and or mechanical rooms.

Revise as follows:

~~C405.2.4~~ C405.2.5 Specific application controls. Specific application controls shall be provided for the following:

1. The following lighting shall be controlled by an occupant sensor complying with Section C405.2.1.1 or a time-switch control complying with Section C405.2.2.1. In addition, a manual control shall be provided to control such lighting separately from the general lighting in the space:
 - 1.1. Display and accent.
 - 1.2. Lighting in display cases.
 - 1.3. Supplemental task lighting, including permanently installed under-shelf or under-cabinet lighting.
 - 1.4. Lighting equipment that is for sale or demonstration in lighting education.
2. *Sleeping units* shall have control devices or systems that are configured to automatically switch off all permanently installed luminaires and switched receptacles within 20 minutes after all occupants have left the unit.

Exceptions:

1. Lighting and switched receptacles controlled by card key controls.
2. Spaces where patient care is directly provided.
3. Permanently installed luminaires within *dwelling units* shall be provided with controls complying with Section C405.2.1.1 or ~~C405.2.2.2, C405.2.3.1.~~
4. Lighting for nonvisual applications, such as plant growth and food warming, shall be controlled by a time switch control complying with Section C405.2.2.1 that is independent of the controls for other lighting within the room or space.

~~C405.2.3~~ C405.2.4 Daylight-responsive controls. *Daylight-responsive controls* complying with Section C405.2.3.1 shall be provided to control the electric lights within *daylight zones* in the following spaces:

1. Spaces with a total of more than 150 watts of *general lighting* within sidelit zones complying with Section C405.2.3.2 *General lighting* does not include lighting that is required to have specific application control in accordance with Section C405.2.4.
2. Spaces with a total of more than 150 watts of *general lighting* within toplit zones complying with Section C405.2.3.3.

Exceptions: Daylight responsive controls are not required for the following:

1. Spaces in health care facilities where patient care is directly provided.
2. Lighting that is required to have specific application control in accordance with Section C405.2.4.
3. Sidelit zones on the first floor above grade in Group A-2 and Group M occupancies.

4. New buildings where the total connected lighting power calculated in accordance with Section C405.3.1 is not greater than the adjusted interior lighting power allowance (LPA_{adj}) calculated in accordance with Equation 4-9

$$LPA_{adj} = \frac{[LPA_{norm} \times (1.0 - 0.4 \times UDZFA / TBFA)]}{1}$$

(Equation 4-9)

where:

LPA_{adj} = Adjusted building interior lighting power allowance in watts.

LPA_{norm} = Normal building lighting power allowance in watts calculated in accordance with Section C405.3.2 and reduced in accordance with Section C406.3 where Option 2 of Section C406.1 is used to comply with the requirements of Section C406.

$UDZFA$ = Uncontrolled daylight zone floor area is the sum of all sidelit and toplit zones, calculated in accordance with Sections C405.2.3.2 and C405.2.3.3, that do not have daylight responsive controls.

$TBFA$ = Total building floor area is the sum of all floor areas included in the lighting power allowance calculation in Section C405.3.2.

Reason: The existing Section C405.2.2 is not straightforward. One of the biggest reasons is that it includes scoping and technical requirements for two different energy savings strategies: switching lights off by time scheduling, and light reduction controls to allow occupants to operate lights at a lower level. The applicability of the requirements for these two strategies is similar, but not identical, resulting in a lot of complicated exceptions. This proposal would untangle these requirements by putting the light reduction controls in a new section C405.2.3. This will dramatically improve the reading of Section C405.2.2 and eliminate several instances where we establish a new control requirement through an exception.

The deletion of exceptions language under C405.2.2 appears to remove the requirement for light reduction controls from the four listed applications, but this requirement is actually maintained (since these applications are not provided with occupant sensor controls, they would still be required to have light reduction controls).

This proposal does not change the applicability or stringency of controls requirements. It is a purely editorial change which makes the code easier to use and enforce.

Cost Impact: The code change proposal will not increase or decrease the cost of construction. This proposal does not change the applicability or stringency of controls requirements. It is a purely editorial change which makes the code easier to use and enforce.

Proposal # 4779

CE175-19

CE176-19

IECC: C405.2, C405.2.2

Proponent: Jack Bailey, representing International Association of Lighting Designers (jbailey@oneluxstudio.com); Glenn Heinmiller, Lam Partners, representing International Association of Lighting Designers (glenn@lampartners.com)

2018 International Energy Conservation Code

Revise as follows:

C405.2 Lighting controls (Mandatory). Lighting systems shall be provided with controls that comply with one of the following.

1. Lighting controls as specified in Sections C405.2.1 through C405.2.6.
2. Luminaire level lighting controls (LLLC) and lighting controls as specified in Sections C405.2.1, C405.2.4 and C405.2.5. The LLLC luminaire shall be independently capable of:
 - 2.1. Monitoring occupant activity to brighten or dim lighting when occupied or unoccupied, respectively.
 - 2.2. Monitoring ambient light, both electric light and daylight, and brighten or dim artificial light to maintain desired light level.
 - 2.3. For each control strategy, configuration and reconfiguration of performance parameters including; bright and dim setpoints, timeouts, dimming fade rates, sensor sensitivity adjustments, and wireless zoning configurations.

Exceptions: Lighting controls are not required for the following:

1. ~~Areas designated as security or emergency areas that are required to be continuously lighted. Spaces where an automatic shutoff would endanger occupant safety or security.~~
2. Interior exit stairways, interior exit ramps and exit passageways.
3. Emergency egress lighting that is normally off.

C405.2.2 Time-switch controls. Each area of the building that is not provided with *occupant sensor controls* complying with Section C405.2.1.1 shall be provided with *time-switch controls* complying with Section C405.2.2.1.

Exception: Where a *manual control* provides light reduction in accordance with Section C405.2.2.2, *time-switch controls* shall not be required for ~~the following:~~

- 1- ~~Spaces~~ spaces where patient care is directly provided.
- 2- ~~Spaces where an automatic shutoff would endanger occupant safety or security.~~
- 3- ~~Lighting intended for continuous operation.~~
- 4- ~~Shop and laboratory classrooms.~~

Reason: The “safety” exception in C405.2 is quite important. If written too narrowly, it can compromise safety. But if written too broadly, it can become a loophole that creates unnecessary exceptions from the lighting controls requirements in the code. Let’s examine the current language.

Areas “designated as security or emergency areas”. Designated by whom? Such designations are shown on floor plans? Is this meant to be limited to 911 call centers and prisons? Or is this meant to include bank branches and fire stations? Refuge areas? Muster points?

“That are required to be continuously lighted”. Required by whom? What jurisdiction requires that lights operate continuously in buildings which are unoccupied? Jurisdictional **lighting** requirements are common – for bank ATM areas, hospitals, swimming pools, kitchens, parking lots, etc. as well as for egress lighting required by IBC. But these requirements are almost always limited in duration – either while the space or building is occupied, while a certain activity is occurring, or after dark for exterior areas. There is almost never a requirement that lights operate continuously. So if this “requirement” that the space be continuously lighted does not come from the jurisdiction, does it come from the building owner?

It is also possible that the current exception does not cover all spaces where lighting controls could endanger occupants. For example, dangerous work is performed in some (but not all) laboratories and workshops.

The proposed language, “Spaces where an automatic shutoff would endanger occupant safety or security” is already an exception from the time-switch controls requirements in section C405.2.2, and it makes sense to apply this language more broadly as the exception from occupant sensor and daylight responsive controls requirements as well.

An “automatic shutoff” could be planned or unplanned, and could be the result of a malfunctioning control system (e.g. occupant sensors shut off lights in an occupied space).

“Would” endanger is strong language. There is no guarantee that any shutoff would endanger occupants, but this is better than the permissive language alternates “could”, “may” etc.

And finally, it is the “occupants” who would need to be endangered. We are not using this as an excuse to leave lights burning continuously for “security” lighting to secure an empty room. In the 21st century we have better ways to secure spaces than leaving the lights on all the time and having a guard walk by occasionally to look in.

Once we have made this change in C405.2 then we can eliminate some additional exceptions in C405.2.2.

- “Lighting intended for continuous operation” has always been problematic. “Intended” by whom? Since it is quite rare for an authority to have such a requirement, this is usually interpreted to mean that a building owner “requires” (i.e. “wants”) the lighting to be operated continuously. If an authority has such a requirement, then that requirement would supercede this code (per C101.3). But even if this is an owner “requirement” at the time the space is built, requirements change over time. A store which is intended to be 24-hour operation may well change to 18-hour operation during an economic downturn, or close and be re-opened by someone else who runs a 12-hour operation.
- “Shop and laboratory classrooms” – if there is a safety concern then the proposed Exception 1 to C405.2 would provide an exemption. It should be noted, however, that in practice many spaces of this type are currently provided with occupant sensors.

Cost Impact: The code change proposal will not increase or decrease the cost of construction. The intent of this proposal is to make existing exceptions clearer and more enforceable, not to change the scope of these exceptions.

Proposal # 4778

CE176-19

CE177-19

IECC: C405.2.2.1

Proponent: Glenn Heinmiller, Lam Partners, representing Self (glenn@lampartners.com); Jack Bailey (jbailey@oneluxstudio.com)

2018 International Energy Conservation Code

Revise as follows:

C405.2.2.1 Time-switch control function. Each space provided with *time-switch controls* shall be provided with a ~~manual control~~ for light reduction control in accordance with Section C405.2.2.2. Time-switch controls shall include an override switching device that complies with the following:

1. Have a minimum 7-day clock.
2. Be capable of being set for seven different day types per week.
3. Incorporate an automatic holiday “shutoff” feature, which turns off all controlled lighting loads for not fewer than 24 hours and then resumes normally scheduled operations.
4. Have program backup capabilities, which prevent the loss of program and time settings for not fewer than 10 hours, if power is interrupted.
5. Include an override switch that complies with the following:
 - 5.1. The override switch shall be a manual control.
 - 5.2. The override switch, when initiated, shall permit the controlled lighting to remain on for not more than 2 hours.
 - 5.3. Any individual override switch shall control the lighting for an area not larger than 5,000 square feet (465 m²).

Exceptions:

1. Within mall concourses, auditoriums, sales areas, manufacturing facilities and sports arenas:
 - 1.1. The time limit shall be permitted to be greater than 2 hours, provided that the switch is a captive key device.
 - 1.2. The area controlled by the override switch shall not be limited to 5,000 square feet (465 m²) provided that such area is less than 20,000 square feet (1860 m²).
2. Where provided with manual control, the following areas are not required to have light reduction control:
 - 2.1. Spaces that have only one luminaire with a rated power of less than 100 watts.
 - 2.2. Spaces that use less than 0.6 watts per square foot (6.5 W/m²).
 - 2.3. Corridors, lobbies, electrical rooms and or mechanical rooms.

Reason: This proposal clarifies of the intent of the code by replacing a confusing phrase with the correct term. The phrase “manual control for lighting reduction” is confusing. It should be replaced with “light-reduction control” which is what this paragraph is referring to. Light-reduction controls are described in C405.2.2.2

Cost Impact: The code change proposal will not increase or decrease the cost of construction
This is only a clarification.

Proposal # 4665

CE177-19

CE178-19

IECC: C405.2.2.1

Proponent: Marilyn Williams, representing National Electrical Manufacturers Association
(mar_williams@nema.org)

2018 International Energy Conservation Code

Revise as follows:

C405.2.2.1 Time-switch control function. Each space provided with *time-switch controls* shall be provided with a *manual control* for light reduction in accordance with Section C405.2.2.2. Time-switch *controls* shall include an override switching device that complies with the following:

1. Have a minimum 7-day clock.
2. Be capable of being set for seven different day types per week.
3. Incorporate an automatic holiday “shutoff” feature, which turns off all controlled lighting loads for not fewer than 24 hours and then resumes normally scheduled operations.
4. Have program backup capabilities, which prevent the loss of program and time settings for not fewer than 10 hours, if power is interrupted.
5. Include an override switch that complies with the following:
 - 5.1. The override switch shall be a manual control.
 - 5.2. The override switch, when initiated, shall permit the controlled lighting to remain on for not more than 2 hours.
 - 5.3. Any individual override switch shall control the lighting for an area not larger than 5,000 square feet (465 m²).

Exceptions:

1. Within mall concourses, auditoriums, sales areas, manufacturing facilities and sports arenas:
 - 1.1. The time limit shall be permitted to be greater than 2 hours, provided that the switch is a captive key device.
 - 1.2. The area controlled by the override switch shall not be limited to 5,000 square feet (465 m²) provided that such area is less than 20,000 square feet (1860 m²).
2. Where provided with *manual control*, the following areas are not required to have light reduction control:
 - 2.1. Spaces that have only one luminaire with a rated power of less than ~~100-60~~ watts.
 - 2.2. Spaces that use less than ~~0.6-0.45~~ watts per square foot (~~6.5-4.9~~ W/m²).
 - 2.3. Corridors, lobbies, electrical rooms and or mechanical rooms.

Reason: Revising this language will:

1 Update the code for use of LED lighting

2. Reduce energy use

As lighting has become more efficient with the use of LEDs, the lighting power density and wattage of luminaires has reduced significantly. However, the Light Reduction Control exception found under C405.2.2.1, has not adjusted accordingly. Both the one luminaire wattage exception (2.1) and the space lighting power density exception (2.2), are the same values as published under the 2009 IECC version. These values use a fluorescent lighting power baseline that is not consistent with either current lighting allowances used in the code

today, nor with the solid state technology that is now the building standard.

The wattage exception for a single luminaire is adjusted to 60 watts, well above the wattage of a standard single 2x4 LED fixture found on the market today. The lighting power exception has been adjusted down by 25% to 0.45 watts per square foot. This aligns with the reduction changes in lighting power density allowance from the 2009 IECC to the proposed values from ASHRAE 90.1-2019.

Cost Impact: The code change proposal will not increase or decrease the cost of construction. There is no cost impact. This editorial change clarifies the code intent and will improve compliance and consistency for energy efficient control of lighting.

Proposal # 4386

CE178-19

CE179-19

IECC: C405.2.2.2

Proponent: Jack Bailey, representing International Association of Lighting Designers (jbailey@oneluxstudio.com); Glenn Heinmiller, representing International Association of Lighting Designers (glenn@lampartners.com)

2018 International Energy Conservation Code

Revise as follows:

C405.2.2.2 Light-reduction controls. Spaces required to have light-reduction controls shall have a manual control controls that allows allow the occupant to occupants to turn the lights off, and reduce the connected lighting load in a reasonably uniform illumination pattern by not less than 50 percent. Lighting reduction shall be achieved by using one of the following or another approved method:

1. ~~Controlling all lamps or luminaires.~~ Continuous dimming of all luminaires from full output to less than 20 percent of full power.
2. ~~Dual switching of alternate rows of luminaires, alternate luminaires or alternate lamps.~~ Switching all luminaires to a reduced output of not less than 30 percent, and not more than 70 percent of full power.
3. ~~Switching the middle lamp luminaires independently of the outer lamps.~~ Switching alternate luminaires or alternate rows of luminaires to achieve a reduced output of not less than 30 percent, and not more than 70 percent of full power.
4. ~~Switching each luminaire or each lamp.->~~

Exception: ~~Light reduction controls are not required in daylight zones with daylight responsive controls complying with Section C405.2.3.~~

Reason: The existing code language referring to switching of “lamps” is outdated. Modern LED luminaires no longer have lamps and are not referred to in this way. When the 2021 IECC is adopted in 2022 and 2023 this terminology will seem archaic. The proposed language is technology neutral, in that it describes a result which can be achieved using either LED or obsolete lighting technologies like fluorescent.

This proposal also incorporates the word “dimming” to clarify that dimming is an acceptable strategy for “light reduction controls”. While dimming is permitted by #1 in the existing code, a surprisingly large number of code users do not understand this because the word “dimming” is not specifically used.

Finally, this proposal fixes a problem with the existing language. As currently written, there is not actually a requirement for an intermediate step between “on” and “off” because “off” is “a reduction of not less than 50 percent”. This proposal specifically requires that an intermediate step be provided between “on” and “off”.

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

Proposal # 4781

CE179-19

CE180-19

IECC: C405.2.2.1

Proponent: Jack Bailey, representing International Association of Lighting Designers (jbailey@oneluxstudio.com); Glenn Heinmiller, representing Self (glenn@lampartners.com)

2018 International Energy Conservation Code

Revise as follows:

C405.2.2.1 Time-switch control function. Each space provided with *time-switch controls* shall be provided with a *manual control* for light reduction in accordance with Section C405.2.2.2. Time-switch *controls* shall ~~include an override switching device that complies with~~ comply with all of the following:

1. Automatically turn off the lights when the space is scheduled to be unoccupied.
2. Have a minimum 7-day clock.
3. Be capable of being set for seven different day types per week.
4. Incorporate an automatic holiday “shutoff” feature, which turns off all controlled lighting loads for not fewer than 24 hours and then resumes normally scheduled operations.
5. Have program backup capabilities, which prevent the loss of program and time settings for not fewer than 10 hours, if power is interrupted.
6. Include an override switch that complies with the following:
 - 6.1. The override switch shall be a manual control.
 - 6.2. The override switch, when initiated, shall permit the controlled lighting to remain on for not more than 2 hours.
 - 6.3. Any individual override switch shall control the lighting for an area not larger than 5,000 square feet (465 m²).

Exceptions:

1. Within mall concourses, auditoriums, sales areas, manufacturing facilities and sports arenas:
 - 1.1. The time limit shall be permitted to be greater than 2 hours, provided that the switch is a captive key device.
 - 1.2. The area controlled by the override switch shall not be limited to 5,000 square feet (465 m²) provided that such area is less than 20,000 square feet (1860 m²).
2. Where provided with *manual control*, the following areas are not required to have light reduction control:
 - 2.1. Spaces that have only one luminaire with a rated power of less than 100 watts.
 - 2.2. Spaces that use less than 0.6 watts per square foot (6.5 W/m²).
 - 2.3. Corridors, lobbies, electrical rooms and or mechanical rooms.

Reason: Somehow this section of the code fails to state the obvious: that time-switch controls automatically turn lights off when the space is scheduled to be unoccupied. Instead there is a confusing statement about an “override switching device”, which describes a relay, but which is usually interpreted by users of the code to be describing a switch which is accessible to occupants. This is doubly-confusing because the list of requirements under C405.2.2.1 is described as establishing requirements for the “override switching device” only, and not for the time-switch system as a whole.

Cost Impact: The code change proposal will not increase or decrease the cost of construction. This editorial change clarifies the code intent and will improve compliance and consistency for energy efficient

automatic lighting shut off control.

Proposal # 4782

CE180-19

CE181-19

IECC: C405.2.2.2

Proponent: Marilyn Williams, representing National Electrical Manufacturers Association
(mar_williams@nema.org)

2018 International Energy Conservation Code

Revise as follows:

C405.2.2.2 Light-reduction controls. Spaces required to have light-reduction controls shall have a *manual control* that allows the occupant to reduce the connected lighting load by not less than 50 percent in a reasonably uniform illumination pattern ~~by not less than 50 percent.~~ with an intermediate step in addition to full on or off, or with continuous dimming control. Lighting reduction shall be achieved by one of the following or another *approved* method:

1. Controlling all lamps or luminaires.
2. Dual switching of alternate rows of luminaires, alternate luminaires or alternate lamps.
3. Switching the middle lamp luminaires independently of the outer lamps.
4. Switching each luminaire or each lamp.

Exception: Light reduction controls are not required in *daylight zones* with *daylight responsive controls* complying with Section C405.2.3.

Reason: Revising this language will:

1. Increase energy efficiency
2. Reduce inconsistency and confusion with light-reduction control requirements
3. Increase code interpretation, application and enforcement
4. Correct an unintended loophole

The ability to reduce light level either by lighting load on/off switch control or by continuous dimming, provides energy savings as well as lighting adjustability benefits for the occupant. The intent of the provision is to allow space occupants to manually reduce their lighting level by at least 50% of lighting load for personal preference, to avoid glare or simply because full lighting levels is not needed in the space. The light-reduction control requirement has a loophole which allows provision compliance without meeting the intent. Manual lighting controls which turns lighting all the way off, can be interpreted as a reduction of the lighting load of "not less than 50 percent." The way the language is written, full shut off would comply with the provision, but would not meet the intent of the code.

The proposed language would indicate light-reduction control is an intermediate step, in addition to lighting full on and full off control steps, typically provided by manual control requirements. This language eliminates the present loop hole allowing no light reduction control, as the code intends just the opposite. The proposed language also clarifies that continuous dimming would comply with the control requirement while providing further adjustability benefits to the space occupants.

Cost Impact: The code change proposal will not increase or decrease the cost of construction. This is an editorial change to clarify the code's intent. It will improve compliance and consistency for energy efficient control of lighting.

CE182-19

IECC: C405.2.2.2

Proponent: Marilyn Williams, representing National Electrical Manufacturers Association
(mar_williams@nema.org)

2018 International Energy Conservation Code

Revise as follows:

C405.2.2.2 Light-reduction controls. Spaces required to have light-reduction controls shall have a *manual control* that allows the occupant to reduce the connected lighting load in a reasonably uniform illumination pattern by not less than 50 percent. Lighting reduction shall be achieved by one of the following or another *approved* method:

1. Controlling all lamps or luminaires.
2. Dual switching of alternate rows of luminaires, alternate luminaires or alternate lamps.
3. Switching the middle lamp luminaires independently of the outer lamps.
4. Switching each luminaire or each lamp.

~~**Exception:** Light reduction controls are not required in *daylight zones with daylight responsive controls* complying with Section C405.2.3.~~

Reason: Revising this language will:

1. Reduce inconsistency and confusion with light-reduction control requirements
2. Reduct energy use
3. Increase code interpretation simplicity
4. Resolve compliance in application, approval and inspection
5. Improve the occupant's ability to operate their lighting

As the controllability of lighting with LED luminaires has simplified both light reduction and automatic daylight responsive controls, this exception is no longer warranted. Removing this exception allows the light-reduction control provision to become more consistent with user controllability of lighting in areas that have automatic daylight responsive controls. This is a win-win, as the occupants retain more controllability in the space and allows the space to operate more energy efficient by giving occupants control to reduct lighting below levels that daylighting responsive control may adjust them.

A practical example is in an office building. Light level reduction control provides the space user manual control to reduce the lighting through dimming the luminaire or uniformaly switching off some fixtures. However, when the space is required to have daylight responsive controls, the controllability and energy savings may be unnecessarily removed due to this exception. The cost of the lighting controls to accomplish both provisions are the same devices with today's LED lighting control technology.

Cost Impact: The code change proposal will not increase or decrease the cost of construction
This is an editorial change to clarify the code's intent. It will improve compliance and consistency for energy efficient control of lighting.

CE183-19

IECC: C405.2.2.2

Proponent: Marilyn Williams, National Electrical Manufacturers Association, representing National Electrical Manufacturers Association

2018 International Energy Conservation Code

Revise as follows:

C405.2.2.2 Light-reduction controls. Spaces required to have light-reduction controls shall have a *manual control* that allows the occupant to reduce the general lighting connected lighting load in a reasonably uniform illumination pattern by not less than 50 percent. Lighting reduction shall be achieved by one of the following or another *approved* method:

1. Controlling all lamps or luminaires.
2. Dual switching of alternate rows of luminaires, alternate luminaires or alternate lamps.
3. Switching the middle lamp luminaires independently of the outer lamps.
4. Switching each luminaire or each lamp.

Exception: Light reduction controls are not required in *daylight zones* with *daylight responsive controls* complying with Section C405.2.3.

Reason: Revising this language will:

1. Reduce inconsistency and confusion with light-reduction control requirements
2. Increase code interpretation simplicity.
3. Will not change the intent or requirements of the code provision.

The International Energy Conservation Code has never clarified which type of lighting the C405.2.2.2 Light Reduction Control requirement applies. Other energy efficiency codes explicitly indicate that light reduction control only applies to what is defined as the "general lighting" (defined in the section C202 General Definitions) in the space. It has been common practice and common interpretation of the IECC light reduction control section to only apply its requirements to space general lighting. Yet, since this is not specifically stated, it could be enforced on other lighting in the space and cause inappropriate confusion and added cost to the construction of buildings.

Application specific lighting or other lighting considered "non-general" lighting, typically cannot be uniformly controlled, nor does it offer a uniform level of illumination to a space that could be easily reduced by at least 50%. These types of lights include under cabinet, supplemental task luminaires, decorative luminaires, wall sconces, display lighting, case lighting, accent lighting and others. The definition of general lighting, states in part, "shall not include decorative lighting or lighting that provides a dissimilar level of illumination to serve a specialized application or feature with such area", highlights lighting not conducive to "reasonably uniform illumination pattern" that is required by the provision.

Specifically including and explicitly providing the language, "general lighting" in the requirement will reduce the interpretation issues and have the code state correctly, what lighting is required to follow light reduction controls. It will also stop mis-application of the requirement intent and reduce construction cost where this mis-application would have otherwise occurred.

This editorial change clarifies the code intent and will improve compliance and consistency for energy efficient control of lighting.

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

The decrease in the cost of construction is a result of clarifying the appropriate lighting required to have reduced level lighting control and not include the cost of controls for non-general lighting unnecessary, where it is a clear mis-application.

Proposal # 4903

CE183-19

CE184-19

IECC: C405.2.3, C405.2.3.1, C405.2.3.2, FIGURE C405.2.3.2

Proponent: Marilyn Williams, representing National Electrical Manufacturers Association
(mar_williams@nema.org)

2018 International Energy Conservation Code

Revise as follows:

C405.2.3 Daylight-responsive controls. *Daylight-responsive controls* complying with Section C405.2.3.1 shall be provided to control the ~~electric lights~~ general lighting within *daylight zones* in the following spaces:

1. Spaces with a total of more than ~~150~~ 120 watts of *general lighting* within sidelit zones complying with Section C405.2.3.2 ~~*General lighting* does not include lighting that is required to have specific application control in accordance with Section C405.2.4.~~
2. Spaces with a total of more than 240 watts of *general lighting* within the primary and secondary sidelit zones complying with Section C405.2.3.2.
3. Spaces with a total of more than ~~150~~ 120 watts of *general lighting* within toplit zones complying with Section C405.2.3.3.

Exceptions: Daylight responsive controls are not required for the following:

1. Spaces in health care facilities where patient care is directly provided.
2. Lighting that is required to have specific application control in accordance with Section C405.2.4.
3. Sidelit zones on the first floor above grade in Group A-2 and Group M occupancies.
4. New buildings where the total connected lighting power calculated in accordance with Section C405.3.1 is not greater than the adjusted interior lighting power allowance (LPA_{adj}) calculated in accordance with Equation 4-9

$$LPA_{adj} = \left[\frac{LPA_{norm} \times (1.0 - 0.4 \times UDZFA / TBFA)}{1.0} \right]$$

(Equation 4-9)

where:

LPA_{adj} = Adjusted building interior lighting power allowance in watts.

LPA_{norm} = Normal building lighting power allowance in watts calculated in accordance with Section C405.3.2 and reduced in accordance with Section C406.3 where Option 2 of Section C406.1 is used to comply with the requirements of Section C406.

$UDZFA$ = Uncontrolled daylight zone floor area is the sum of all sidelit and toplit zones, calculated in accordance with Sections C405.2.3.2 and C405.2.3.3, that do not have daylight responsive controls.

$TBFA$ = Total building floor area is the sum of all floor areas included in the lighting power allowance calculation in Section C405.3.2.

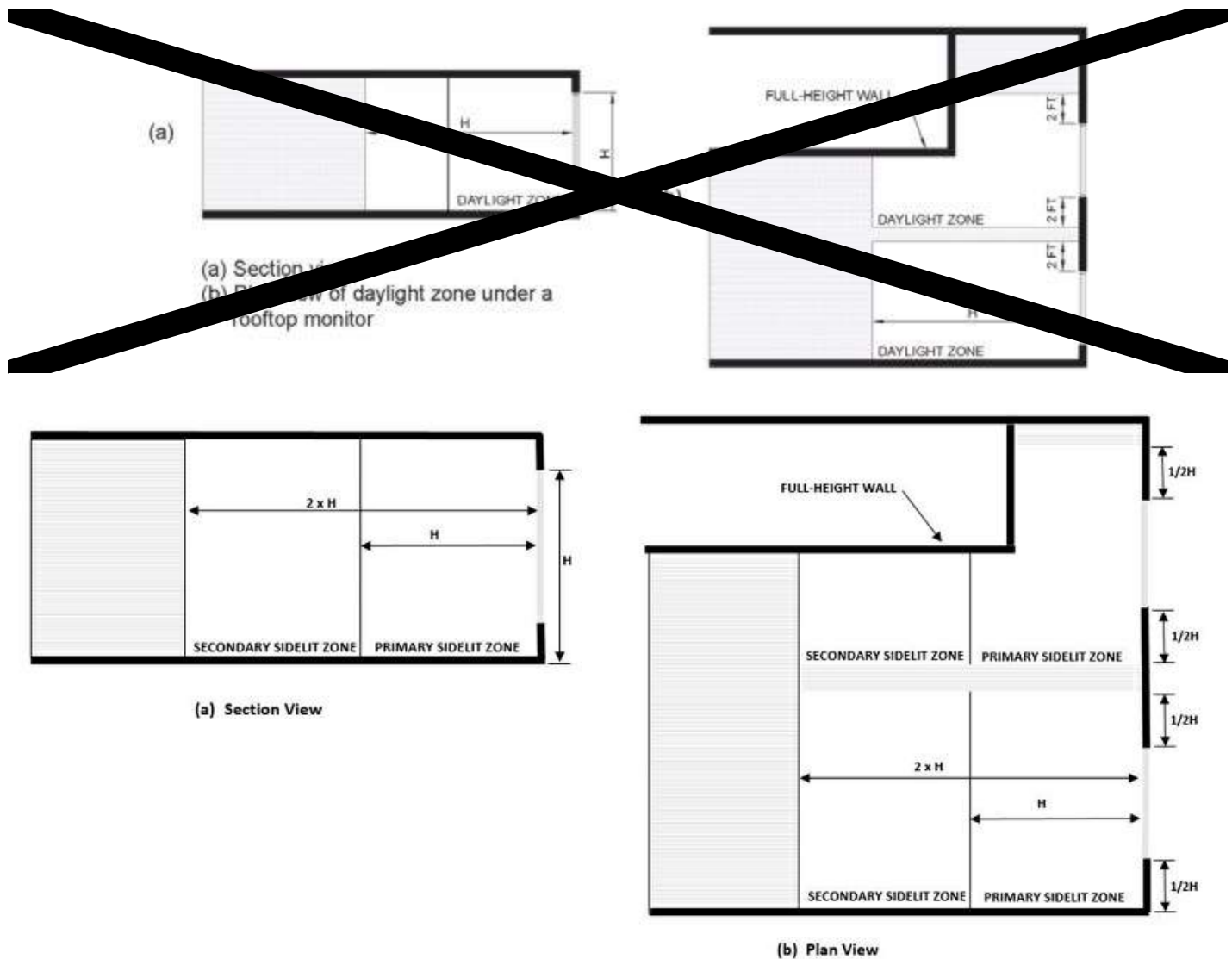
C405.2.3.1 Daylight-responsive control function. Where required, *daylight-responsive controls* shall be provided within each space for control of lights in that space and shall comply with all of the following:

1. Lights in *toplit zones* in accordance with Section C405.2.3.3 shall be controlled independently of lights in *sidelit zones* in accordance with Section C405.2.3.2.
2. Lights in the primary sidelit zone shall be controlled independent of lighting in the secondary sidelit zone.
3. *Daylight responsive controls* within each space shall be configured so that they can be calibrated from within that space by authorized personnel.
4. Calibration mechanisms shall be in a location with *ready access*.
5. Where located in offices, classrooms, laboratories and library reading rooms, *daylight responsive controls* shall dim lights continuously from full light output to 15 percent of full light output or lower.
6. *Daylight responsive controls* shall be configured to completely shut off all controlled lights.
7. Lights in *sidelit zones* in accordance with Section C405.2.3.2 facing different cardinal orientations [within 45 degrees (0.79 rad) of due north, east, south, west] shall be controlled independently of each other.

Exception: Up to 150 watts of lighting in each space is permitted to be controlled together with lighting in a daylight zone facing a different cardinal orientation.

C405.2.3.2 Sidelit zone. The sidelit ~~zone~~ is zones are the floor area adjacent to vertical *fenestration* that complies with all of the following:

1. Where the fenestration is located in a wall, the primary sidelit zone shall extend laterally to the nearest full-height wall, or up to 1.0 times the height from the floor to the top of the fenestration, and longitudinally from the edge of the fenestration to the nearest full-height wall, or up to ~~2 feet (610 mm);~~ 1/2 the height from the floor to the top of the fenestration, whichever is less, as indicated in Figure C405.2.3.2.
2. The secondary sidelit zone is directly adjacent to the primary sidelit zone and shall extend laterally up to 2.0 times, the height from the floor to the top of the fenestration, or to the nearest full height wall, and longitudinally from the edge of the fenestration to the nearest full height wall, or up to 0.5 times the height from the floor to the top of the fenestration, whichever is less, as indicated in Figure C405.2.3.2.
3. The area of the fenestration is not less than 24 square feet (2.23 m²).
4. The distance from the fenestration to any building or geological formation that would block *access to daylight* is greater than the height from the bottom of the fenestration to the top of the building or geologic formation.
5. The visible transmittance of the fenestration is not less than 0.20.



**FIGURE C405.2.3.2
SIDELIT ZONE**

Reason: Increases energy efficiency and aligns with ASHRAE 90.1 and Title 24 Part 6.

General lighting is what must be controlled in a daylight zone, controlled task lighting or decorative lighting can be controlled too but should not be mandatory to do so. Also, the proposal strikes this sentence, "General lighting does not include lighting that is required to have specific application control in accordance with Section C405.2.4" because it's not needed as the definition of general lighting already says this.

The proposal also slightly lowers the wattage threshold to match what's already been vetted in the Title 24 Part 6 standard. The new 120W threshold better aligns with the use of energy efficient LED lighting and still provide for increased cost-effective energy savings (see cost impact in the attachment)

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

This proposed change increases energy efficiency costly effectively by reducing additional lighting load when lighting is offset by daylight. It increases the cost of construction through the addition of daylight responsive controls for the spaces that use at least 120W of lighting power in a daylight zone, instead of the existing IECC threshold of 150W. Also, not that the addition of a secondary daylight zone does not increase the cost as the same daylight responsive control system to control the lighting in the primary daylight zone can be used to control the lighting in the secondary daylight zone. So, no addition equipment is needed.

CE185-19

IECC: C405.2.3.1

Proponent: Jack Bailey, One Lux Studio, representing International Association of Lighting Designers (jbailey@oneluxstudio.com); Glenn Heinmiller, Lam Partners, representing International Association of Lighting Designers (glenn@lampartners.com)

2018 International Energy Conservation Code

Revise as follows:

C405.2.3.1 Daylight-responsive control function. Where required, daylight-responsive controls shall be provided within each space for control of lights in that space and shall comply with all of the following:

1. Lights in toplit zones in accordance with Section C405.2.3.3 shall be controlled independently of lights in sidelit zones in accordance with Section C405.2.3.2.
2. Daylight responsive controls within each space shall be configured so that they can be calibrated from within that space by authorized personnel.
3. Calibration mechanisms shall be in a location with ready access.
4. ~~Where located in offices, classrooms, laboratories and library reading rooms, daylight~~ Daylight responsive controls shall dim lights continuously from full light output to 15 percent of full light output or lower.
5. Daylight responsive controls shall be configured to completely shut off all controlled lights.
6. Lights in sidelit zones in accordance with Section C405.2.3.2 facing different cardinal orientations [within 45 degrees (0.79 rad) of due north, east, south, west] shall be controlled independently of each other.

Exception: Up to 150 watts of lighting in each space is permitted to be controlled together with lighting in a daylight zone facing a different cardinal orientation.

Reason: Currently daylight responsive controls are only required to dim lights in offices, classrooms, laboratories, and library reading rooms. In all other spaces, daylight responsive controls are only required to switch lights off.

Switching lights off leaves a lot of potential energy savings "on the table", as the daylight responsive controls will only save energy when there is sufficient daylight to entirely replace the electric lights. In some installations this may never happen. By contrast, when dimming is required, there will be energy savings whenever there is any useful daylight in the space. Making this change will result in additional energy savings in literally every installation.

This change is feasible today because of the incredibly fast penetration of LED technology into the marketplace. LED luminaires are already almost universally dimmable, and taking advantage of this capability will usually mean running a couple of additional wires. This cost is trivial compared to the cost of installing and commissioning the control systems to begin with.

Functionally, we know that dimming is preferred by building occupants, since the change in light levels is less noticeable, so this will also qualitatively improve the lighting, and increase user acceptance of the controls.

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

Dimming is already the preferred strategy for daylight responsive control of interior lights, and is almost universally used in new construction. With increasing penetration of LED technology in coming years, the cost increase compared to switching will be trivial. But still, there will be some additional cost.

CE186-19

IECC: C405.2.3

Proponent: Glenn Heinmiller, Lam Partners, representing International Association of Lighting Designers (glenn@lampartners.com); Jack Bailey, representing International Association of Lighting Designers (jbailey@oneluxstudio.com)

2018 International Energy Conservation Code

Revise as follows:

C405.2.3 Daylight-responsive controls. *Daylight-responsive controls* complying with Section C405.2.3.1 shall be provided to control the electric lights within *daylight zones* in the following spaces:

1. Spaces with a total of more than 150 watts of *general lighting* within sidelit zones complying with Section C405.2.3.2 *General lighting* does not include lighting that is required to have specific application control in accordance with Section C405.2.4.
2. Spaces with a total of more than 150 watts of *general lighting* within toplit zones complying with Section C405.2.3.3.

Exceptions: Daylight responsive controls are not required for the following:

1. Spaces in health care facilities where patient care is directly provided.
2. Lighting that is required to have specific application control in accordance with Section C405.2.4.
3. Sidelit zones on the first floor above grade in Group A-2 and Group M occupancies.
4. ~~New buildings where the total connected lighting power calculated in accordance with Section C405.3.1 is not greater than the adjusted interior lighting power allowance (LPA_{adj}) calculated in accordance with Equation 4-9~~

~~$$LPA_{adj} = \left[LPA_{norm} \times (1.0 - 0.4 \times UDZFA / TBFA) \right]$$~~

~~(Equation 4-9)~~

~~where:~~

~~LPA_{adj} = Adjusted building interior lighting power allowance in watts.~~

~~LPA_{norm} = Normal building lighting power allowance in watts calculated in accordance with Section C405.3.2 and reduced in accordance with Section C406.3 where Option 2 of Section C406.1 is used to comply with the requirements of Section C406.~~

~~$UDZFA$ = Uncontrolled daylight zone floor area is the sum of all sidelit and toplit zones, calculated in accordance with Sections C405.2.3.2 and C405.2.3.3, that do not have daylight responsive controls.~~

~~$TBFA$ = Total building floor area is the sum of all floor areas included in the lighting power allowance calculation in Section C405.3.2.~~

Reason: Exception #4 was added to IECC 2018. It created unnecessary complexity with no benefit. It does not improve energy efficiency or the usability of the code -- and actually does the opposite. Exception #4 attempts to solve a problem that does not exist. The "problem" is assumed to be that the installation of daylight responsive controls is an unreasonable burden. This was not the case three years ago, and is not the case

today. Designers have not, and are not, asking for this exception. We believe that this exception will hurt energy efficiency in the long run by discouraging the use of daylight responsive controls. While designers welcome alternate paths around unreasonable requirements, we do not welcome alternate paths that provide no benefit and only make the code more complex and confusing.

Cost Impact: The code change proposal will not increase or decrease the cost of construction. Because this proposal eliminates an option to avoid the small cost of installing daylight responsive controls (if certain power density limits are met), it could conceivably increase the cost of construction slightly. But this assumes that the option would commonly be taken. We believe that the option currently in the code is unlikely to be used. Daylight responsive controls are standard practice today and we believe will likely be installed anyhow, regardless of whether or not this option is available. Therefore a possible small increase in construction cost is only a hypothetical and not a given.

Proposal # 4594

CE186-19

CE187-19

IECC: C405.2.3, C405.2.3.1, C405.2.3.2, FIGURE C405.2.3.2

Proponent: Jonathan McHugh, representing McHugh Energy Consultants Inc. (jon@mchughenergy.com)

2018 International Energy Conservation Code

Revise as follows:

C405.2.3 Daylight-responsive controls. *Daylight-responsive controls* complying with Section C405.2.3.1 shall be provided to control the electric lights general lighting within the following daylight zones in the following spaces:

1. Spaces with Primary sidelit zones where a total of more than 150 watts of *general lighting per space* are within sidelit zones complying with Section C405.2.3.2 *General lighting* does not include lighting that is required to have specific application control in accordance with Section C405.2.4.
2. Secondary sidelit zones where a total of more than 300 watts of general lighting per space are within the primary and secondary sidelit zones complying with Section C405.2.3.2.
3. Toplit zones where Spaces with a total of more than 150 watts of *general lighting per space* are within toplit zones complying with Section C405.2.3.3.

Exceptions: Daylight responsive controls are not required for the following:

1. Spaces in health care facilities where patient care is directly provided.
2. Lighting that is required to have specific application control in accordance with Section C405.2.4.
3. Sidelit zones on the first floor above grade in Group A-2 and Group M occupancies.
4. ~~New buildings where the total connected lighting power calculated in accordance with Section C405.3.1 is not greater than the adjusted interior lighting power allowance (LPA_{adj}) calculated in accordance with Equation 4-9~~

~~$$LPA_{adj} = \frac{[LPA_{norm} \times (1.0 - 0.4 \times UDZFA / TBFA)]}{1}$$~~

~~(Equation 4-9)~~

~~where:~~

~~LPA_{adj} = Adjusted building interior lighting power allowance in watts.~~

~~LPA_{norm} = Normal building lighting power allowance in watts calculated in accordance with Section C405.3.2 and reduced in accordance with Section C406.3 where Option 2 of Section C406.1 is used to comply with the requirements of Section C406.~~

~~$UDZFA$ = Uncontrolled daylight zone floor area is the sum of all sidelit and toplit zones, calculated in accordance with Sections C405.2.3.2 and C405.2.3.3, that do not have daylight responsive controls.~~

~~$TBFA$ = Total building floor area is the sum of all floor areas included in the lighting power allowance calculation in Section C405.3.2.~~

C405.2.3.1 Daylight-responsive control function. Where required, *daylight-responsive controls* shall be provided within each space for control of lights in that space and shall comply with all of the following:

1. Lights in *toplit* zones in accordance with Section C405.2.3.3 shall be controlled independently of lights in *sidelit* zones in accordance with Section C405.2.3.2.
2. Lights in the primary sidelit zone shall be controlled independently of lights in the secondary sidelit zone.
3. *Daylight responsive controls* within each space shall be configured so that they can be calibrated from within that space by authorized personnel.
4. Calibration mechanisms shall be in a location with *ready access*.
5. Where located in offices, classrooms, laboratories and library reading rooms, *daylight responsive controls* shall dim lights continuously from full light output to 15 percent of full light output or lower.
6. *Daylight responsive controls* shall be configured to completely shut off all controlled lights.
7. Lights in *sidelit* zones in accordance with Section C405.2.3.2 facing different cardinal orientations [within 45 degrees (0.79 rad) of due north, east, south, west] shall be controlled independently of each other.

Exception: Up to 150 watts of lighting in each space is permitted to be controlled together with lighting in a daylight zone facing a different cardinal orientation.

C405.2.3.2 Sidelit zone. The sidelit zone is the floor area adjacent to vertical *fenestration* that complies with all of the following:

1. Where the fenestration is located in a wall, the sidelit zone shall extend laterally to the nearest full-height wall, or up to 1.0 times the height from the floor to the top of the fenestration, and longitudinally from the edge of the fenestration to the nearest full-height wall, or up to 2 feet (610 mm), whichever is less, as indicated in Figure C405.2.3.2.
2. The secondary sidelit zone is directly adjacent to the primary sidelit zone and shall extend laterally to 2.0 times the height from the floor to the top of the fenestration or to the nearest full height wall whichever is less, and longitudinally from the edge of the fenestration to the nearest full height wall, or up to 2 feet whichever is less, as indicated in Figure C405.2.3.2. If the adjacent primary sidelit zone ends at a full height wall, there is no secondary sidelit zone beyond the wall.
3. The area of the fenestration is not less than 24 square feet (2.23 m²).
4. The distance from the fenestration to any building or geological formation that would block *access to* daylight is greater than the height from the bottom of the fenestration to the top of the building or geologic formation.
5. The visible transmittance of the fenestration is not less than 0.20.

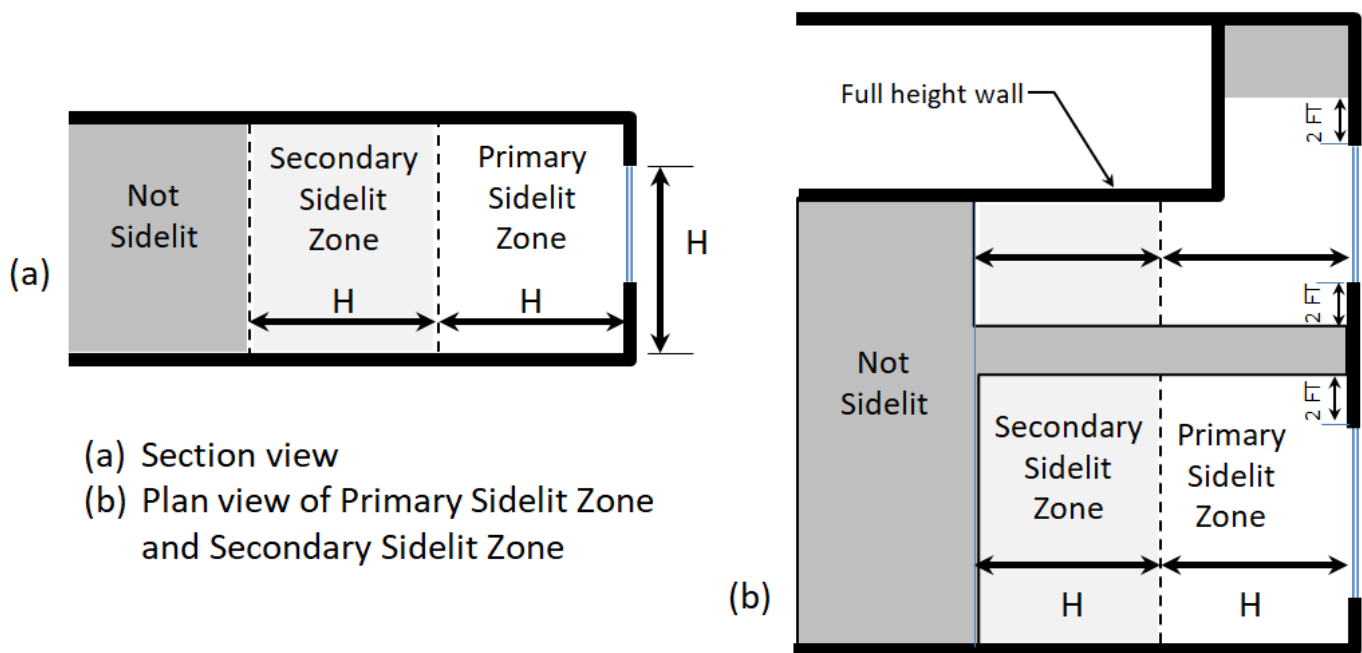
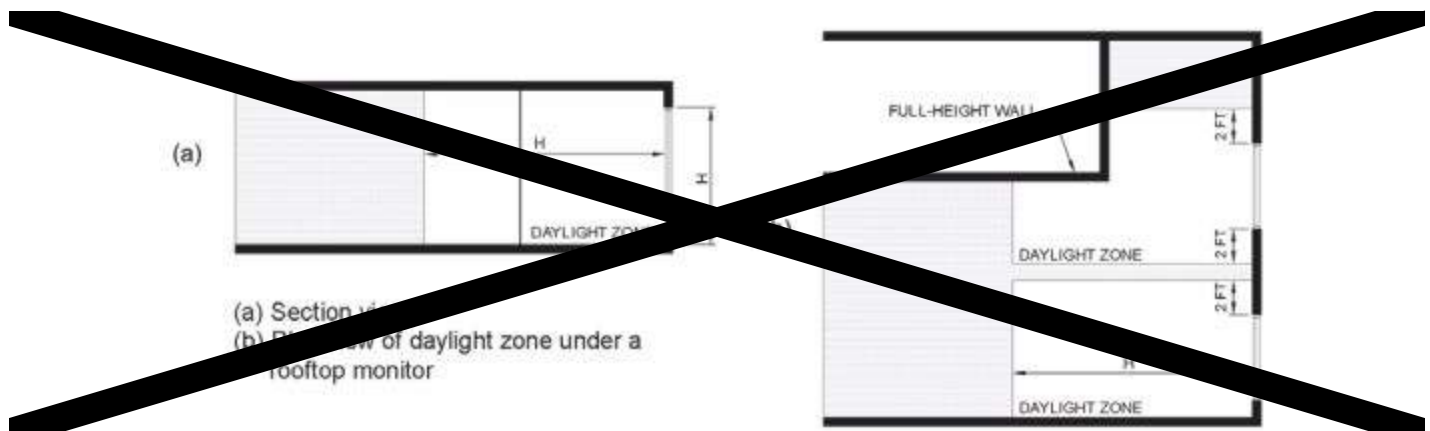


FIGURE C405.2.3.2
PRIMARY AND SECONDARY SIDELIT ZONE

Reason: The addition of the secondary sidelit zone to the 2021 IECC would align the IECC with ASHRAE 90.1, California's Title 24 and the Washington State Energy Code. Adding the secondary sidelit zone would increase the energy savings from sidelighting by approximately 33% for little marginal cost since many daylight controls are multi-channel and can use one photosensor and one controller to set different daylight response curves for each channel.

Exception 4 to C405.2.3 is not needed as the measure is cost-effective whenever the total wattage in the daylight zones exceed the 150 watt threshold. Removing this exception would reduce the complexity of enforcing the code.

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

The PNNL cost study found that the secondary sidelit zone only requires an extra power pack since the same sensor and a multi-channel controller can be used. From the CASE study they documented that the addition of the power pack increased the cost of the control system by 25% while doubling the controlled area (but saving about a third of the energy as the secondary zone is further away from windows).

CE188-19

IECC: C405.2.3.1

Proponent: Jonathan McHugh, representing McHugh Energy Consultants Inc. (jon@mchughenergy.com)

2018 International Energy Conservation Code

Revise as follows:

C405.2.3.1 Daylight responsive control function. Where required, daylight-responsive *controls* shall be provided within each space for control of lights in that space and shall comply with all of the following:

1. Lights in *toplit zones* in accordance with Section C405.2.3.3 shall be controlled independently of lights in *sidelit zones* in accordance with Section C405.2.3.2.
2. *Daylight responsive controls* within each space shall be configured so that they can be calibrated from within that space by authorized personnel.
3. Calibration mechanisms shall be in a location with *ready access*.
4. Where located in offices, classrooms, laboratories and library reading rooms, *daylight responsive controls* shall dim lights continuously from full light output to 15 percent of full light output or lower. In all other spaces, *daylight responsive controls* shall dim lights continuously from full output to 20 percent of full light output or reduce power to between 30 and 70 percent of full power by controlling all luminaires to a reduced light output or by switching alternate luminaires.
5. *Daylight responsive controls* shall be configured to completely shut off all controlled lights.
6. Lights in *sidelit zones* in accordance with Section C405.2.3.2 facing different cardinal orientations [within 45 degrees (0.79 rad) of due north, east, south, west] shall be controlled independently of each other.

Exception: Up to 150 watts of lighting in each space is permitted to be controlled together with lighting in a daylight zone facing a different cardinal orientation.

Reason: Currently the IECC daylight-responsive controls requirements includes dimming for a few spaces and for all other spaces, a minimally compliant daylight-responsive control only need turn the lights off under full daylight availability. For light sources that are difficult to dim continuously (such as HID), the savings associated with daylight controls is substantially less than it could be with multi-level controls. Multi-level controls increase energy savings by approximately 50% as compared to on/off controls. This is documented in the CASE sidelighting and skylighting reports. By allowing other forms of multi-level controls besides continuous dimming, the code is being technology neutral and accommodating light sources that are hard to dim. Requiring multi-levels switching or continuous dimming for daylighting controls is aligned with most other energy codes in the United States including ASHRAE 90.1.

Bibliography:

CASE (Codes and Standards Enhancement Updates to Title 24 Treatment of Skylights. 2005 California Title 24 Building Energy Efficiency Standards. May 2002.

https://mchughenergy.com/papers/2002-05-17_SKY-LT_PROP_T24.pdf

CASE (Codes and Standards Enhancement) Draft Report Sidelighting – Daylighting Requirements for Sidelit Areas near Windows. 2008 California Title 24 Building Energy Efficiency Standards July 6, 2006

https://mchughenergy.com/papers/2006-07-07_DRAFT_SIDELIGHTING_REP.pdf

HMG/PNNL 90.1 Skylighting Requirements Code Change Proposal, Submitted to ASHRAE 90.1 Standard

Envelope and Lighting Subcommittees June 2008.

https://mchughenergy.com/papers/PNNL_Daylight901_pt4.pdf

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

As documented in the HMG/PNNL (2008) report “As a result of discussion with the ASHRAE 90.1 Lighting Subcommittee, the following variable and fixed costs were associated with dimming and switching controls systems. For switching control systems the additional circuiting costs associated with bi-level switching is \$0.108/sf...” In comparison for warehouse spaces, the added life cycle savings from using multi-level controls instead of On/Off controls are around \$0.25/sf (CASE 2002) and in sidelit spaces the life cycle savings are around \$0.50/sf. (CASE 2006). Thus the added costs are well outweighed by the life cycle savings.

Proposal # 5574

CE188-19

CE189-19

IECC: C405.2.3, C405.2.3.1, C405.2.3.2, FIGURE C405.2.3.2

Proponent: Marilyn Williams, representing National Electrical Manufacturers Association
(mar_williams@nema.org)

2018 International Energy Conservation Code

Revise as follows:

C405.2.3 Daylight-responsive controls. *Daylight-responsive controls* complying with Section C405.2.3.1 shall be provided to control the electric lights within *daylight zones* in the following spaces:

1. Spaces with a total of more than 150 watts of *general lighting* within the primary sidelit zones complying with Section C405.2.3.2. ~~*General lighting* does not include lighting that is required to have specific application control in accordance with Section C405.2.4.~~
2. Spaces with a total of more than ~~150~~ 300 watts of *general lighting* within ~~toplit~~ the primary and secondary sidelit zones complying with Section ~~C405.2.3.3~~ C405.2.3.2.

Exceptions: Daylight responsive controls are not required for the following:

1. Spaces in health care facilities where patient care is directly provided.
2. Lighting that is required to have specific application control in accordance with Section C405.2.4.
3. Sidelit zones on the first floor above grade in Group A-2 and Group M occupancies.
4. New buildings where the total connected lighting power calculated in accordance with Section C405.3.1 is not greater than the adjusted interior lighting power allowance (LPA_{adj}) calculated in accordance with Equation 4-9

$$LPA_{adj} = [LPA_{norm} \times (1.0 - 0.4 \times UDZFA / TBFA)]$$

(Equation 4-9)

where:

LPA_{adj} = Adjusted building interior lighting power allowance in watts.

LPA_{norm} = Normal building lighting power allowance in watts calculated in accordance with Section C405.3.2 and reduced in accordance with Section C406.3 where Option 2 of Section C406.1 is used to comply with the requirements of Section C406.

$UDZFA$ = Uncontrolled daylight zone floor area is the sum of all sidelit and toplit zones, calculated in accordance with Sections C405.2.3.2 and C405.2.3.3, that do not have daylight responsive controls.

$TBFA$ = Total building floor area is the sum of all floor areas included in the lighting power allowance calculation in Section C405.3.2.

C405.2.3.1 Daylight-responsive control function. Where required, *daylight-responsive controls* shall be provided within each space for control of lights in that space and shall comply with all of the following:

1. Lights in *toplit zones* in accordance with Section C405.2.3.3 shall be controlled independently of

lights in sidelit zones in accordance with Section C405.2.3.2.

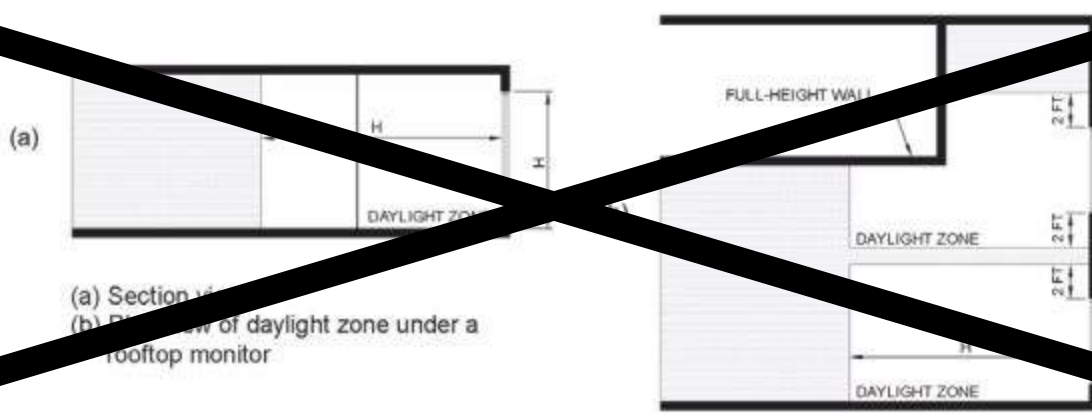
2. Lights in the primary sidelit zone shall be controlled independent of lighting in the secondary sidelit zone.
3. *Daylight responsive controls* within each space shall be configured so that they can be calibrated from within that space by authorized personnel.
4. Calibration mechanisms shall be in a location with *ready access*.
5. Where located in offices, classrooms, laboratories and library reading rooms, *daylight responsive controls* shall dim lights continuously from full light output to 15 percent of full light output or lower.
6. *Daylight responsive controls* shall be configured to completely shut off all controlled lights.
7. Lights in *sidelit zones* in accordance with Section C405.2.3.2 facing different cardinal orientations [within 45 degrees (0.79 rad) of due north, east, south, west] shall be controlled independently of each other.

Exception: Up to 150 watts of lighting in each space is permitted to be controlled together with lighting in a daylight zone facing a different cardinal orientation.

C405.2.3.2 Sidelit primary and secondary zone. The sidelit ~~zone is~~ zones are the floor area adjacent to vertical *fenestration* that complies with all of the following:

1. Where the fenestration is located in a wall, the primary sidelit zone shall extend laterally to the nearest full-height wall, or up to 1.0 times the height from the floor to the top of the fenestration, and longitudinally from the edge of the fenestration to the nearest full-height wall, or up to ~~2 feet (610 mm)~~ 0.5 times the height from the floor to the top of the fenestration, whichever is less, as indicated in Figure C405.2.3.2.
2. The secondary sidelit zone is directly adjacent to the primary sidelit zone and shall extend laterally from 1.0 times to 2.0 times the height from the floor to the top of the fenestration to the nearest full height wall, or up to 1.0 times the height from the floor to the top of the fenestration, and longitudinally from the edge of the fenestration to the nearest full height wall, or up to 0.5 times the height from the floor to the top of the fenestration, whichever is less, as indicated in Figure C405.2.3.2. If the adjacent primary sidelit zone ends at a full height wall, there is no secondary sidelit zone beyond such obstruction.
3. The area of the fenestration is not less than 24 square feet (2.23 m²).
4. The distance from the fenestration to any building or geological formation that would block *access to* daylight is greater than the height from the bottom of the fenestration to the top of the building or geologic formation.
5. The visible transmittance of the fenestration is not less than 0.20.

Delete and substitute as follows:



**FIGURE C405.2.3.2
SIDELIT ZONE**

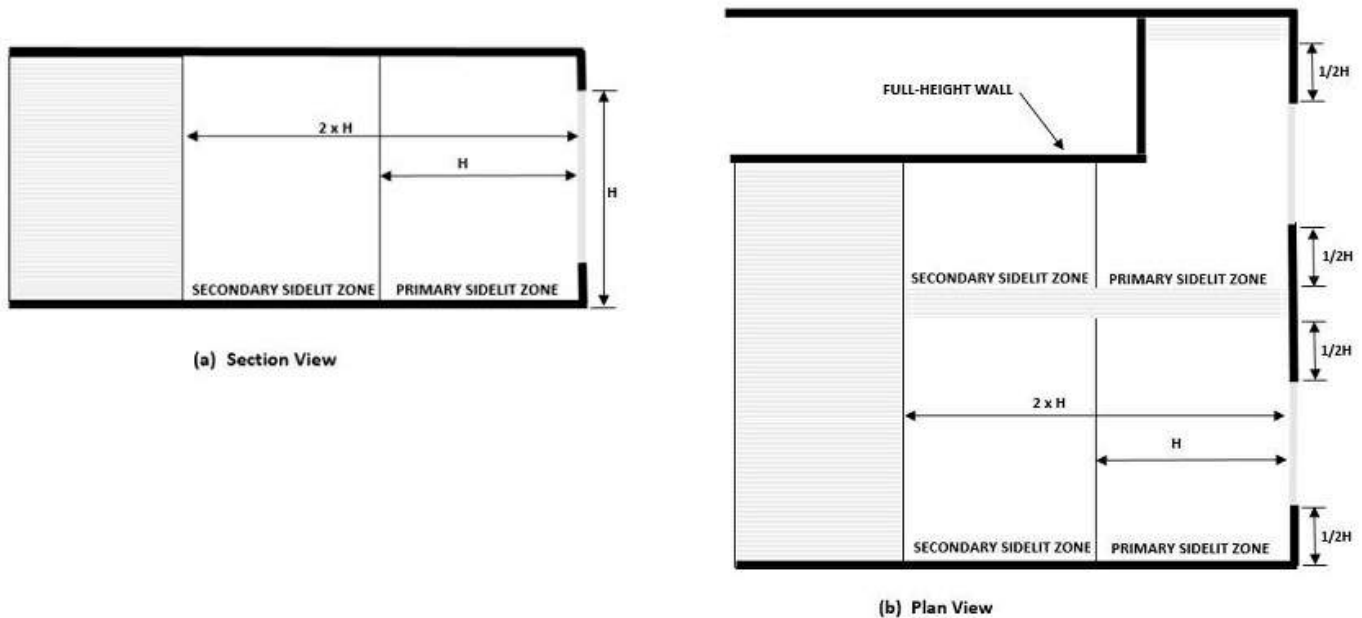


FIGURE C405.2.3.2
SIDELIT ZONE

Reason: Revising this language will:

1. Reduce inconsistency and application confusion with daylight responsive controls
2. Reduce energy use
3. Increase code interpretation
4. Resolve compliance in application, approval and inspection
5. Simplify design and compliance by aligning with other energy efficiency codes.

The contribution of daylight through vertical fenestration (windows) into a space, extends laterally much further into the space than the current code's defined area for a single sidelight daylight zone. In many applications, the change in the 2015 IECC definition of daylighting zones reduced the daylighting area, yet daylight can still project much further into the side lighting space. A secondary sidelit daylighting zone can further reduce the electric lighting level in response to daylighting contribution to this area, saving added energy.

Evaluation studies performed by the Pacific Northwest National Laboratory extensively reviewed the viability of a secondary daylighting zone across six climate zones, four common window to wall ratios, with and without blinds, and with nine visual lighting transmission ratios. A secondary daylighting zone was determined to be cost effective down to 120 watts of controlled power.

See: Daylighting Analysis for ASHRAE 90.1 Code Development – Final Results, March 29, 2012, PNNL: Athalye, Xie, Rosenberg, Liu and Hescong Mahone Group: Saxena, Perry, Chappell.

For simplicity of the code and compliance, this secondary sidelit zone is the same dimension, and sits adjacent to the primary sidelit zone, and parallel to the wall fenestration. The primary and secondary daylighting controls operate independently to adjust electric lighting given the differing daylight level contributions in each zone. The controls maintain space occupant visual acuity and comfort by maintaining the design foot candle levels.

By requiring the toplit and sidelit daylight zones to be shown on the construction documents, it simplifies inspection and enforcement of this provision.

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

This proposed change increases energy efficiency by reducing additional space lighting power with the offset of daylight further into the building space than the primary sidelit zone.

Feasibility and cost studies were conducted in the cited research “Daylighting Analysis for ASHRAE 90.1 Code Development”. In the cost feasibility, the research incorporated the added cost of photocontrols, installation and commissioning. This cost analysis comprehensively included both the fixed control costs and variable costs of wiring and installation, with the number of fixtures, at standard Union Electrician Labor Rates. Averaging across climate zones, typical window to wall ratios, and average building orientations, the study showed adding a secondary daylight area increases cost effectiveness over just a primary sidelight daylight area. Using the typical nine-year scaler, the benefit to cost ratio for a building with 0.2 visible light transmittance (fairly low transmittance) demonstrated a breakeven point at 120W of lighting controlled with only a primary daylighting area. When the secondary daylighting area was included, the breakeven point dropped to 100W of lighting controlled. The current code threshold is at 150W controlled lighting, well above the cited breakeven points, thus putting the Benefit Cost Ratio at 1.2 for adding the secondary daylighting area at 150W of lighting controlled.

Proposal # 4391

CE189-19

CE190-19

IECC: C405.2.3.2

Proponent: Jack Bailey, representing International Association of Lighting Designers (jbailey@oneluxstudio.com); Glenn Heinmiller, Lam Partners, representing International Association of Lighting Designers (glenn@lampartners.com)

2018 International Energy Conservation Code

Revise as follows:

C405.2.3.2 Sidelit zone. The sidelit zone is the floor area adjacent to vertical *fenestration* that complies with all of the following:

1. Where the fenestration is located in a wall, the sidelit zone shall extend laterally to the nearest full-height wall, or up to 1.0 times the height from the floor to the top of the fenestration, and longitudinally from the edge of the fenestration to the nearest full-height wall, or up to 2 feet (610 mm), whichever is less, as indicated in Figure C405.2.3.2.
2. The area of the fenestration is not less than 24 square feet (2.23 m²).
3. The distance from the fenestration to any building or geological formation that would block *access to daylight* is greater than one half of the height from the bottom of the fenestration to the top of the building or geologic formation.
4. The visible transmittance of the fenestration is not less than 0.20.

Reason: This change would greatly expand the applicability of daylight responsive controls requirements in cities, where there is significant overshadowing from adjacent buildings, and would conform the requirements in the IECC to those in Standard 90.1 and California T24. For buildings in urban areas, daylight responsive controls would be required on lower floors of buildings where they are currently not required.

Cost Impact: The code change proposal will increase the cost of construction
This proposal would increase the cost of construction by expanding the scope daylight responsive controls requirements.

Proposal # 4785

CE190-19

CE191-19

IECC: C405.2.3.2, FIGURE C405.2.3.2

Proponent: Marilyn Williams, representing National Electrical Manufacturers Association
(mar_williams@nema.org)

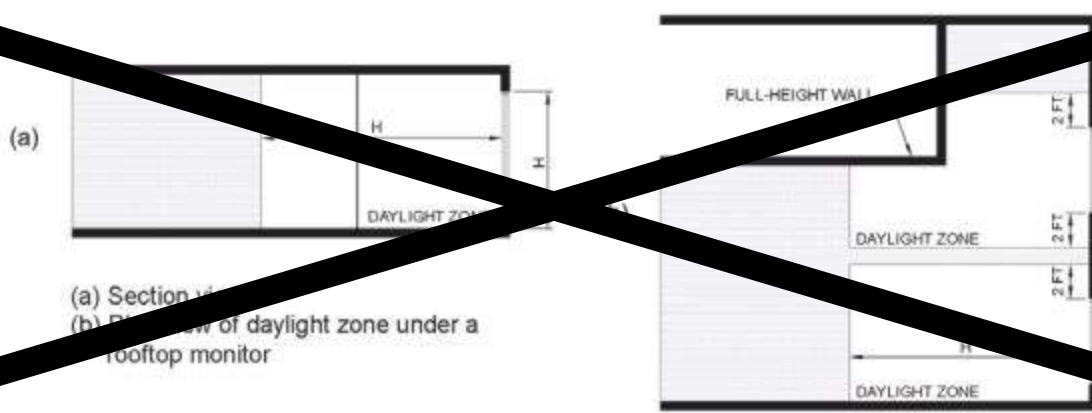
2018 International Energy Conservation Code

Revise as follows:

C405.2.3.2 Sidelit zone. The sidelit zone is the floor area adjacent to vertical *fenestration* that complies with all of the following:

1. Where the fenestration is located in a wall, the primary sidelit zone shall extend laterally to the nearest full-height wall, or up to 1.0 times the height from the floor to the top of the fenestration, and longitudinally from the edge of the fenestration to the nearest full-height wall, or up to ~~2 feet (610 mm)~~ 1/2 the height from the floor to the top of the fenestration, whichever is less, as indicated in Figure C405.2.3.2.
2. The area of the fenestration is not less than 24 square feet (2.23 m²).
3. The distance from the fenestration to any building or geological formation that would block *access to* daylight is greater than the height from the bottom of the fenestration to the top of the building or geologic formation.
4. The visible transmittance of the fenestration is not less than 0.20.

Delete and substitute as follows:



**FIGURE C405.2.3.2
SIDELIT ZONE**

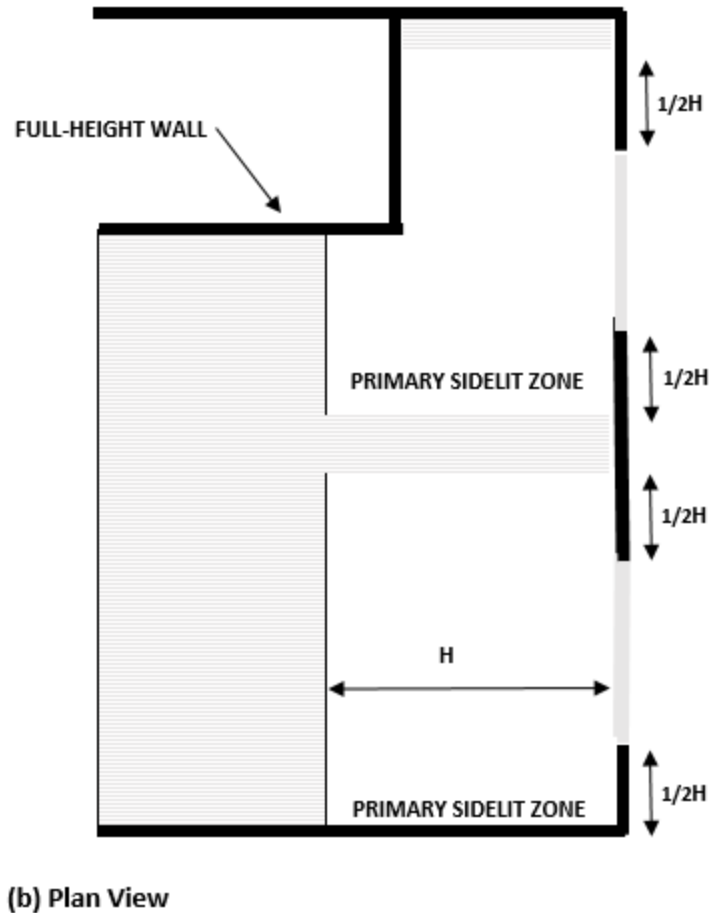


FIGURE C405.2.3.2
SIDELIT ZONE

Reason: Revising this language will:

1. Reduce inconsistency and application confusion with daylight responsive controls
2. Reduce energy use for taller vertical fenestrations
3. Resolve compliance in application, approval and inspection.
4. Simplify design and compliance by aligning with other energy efficiency codes.

By changing the sidelit daylighting zone horizontal dimension from two feet from the vertical fenestration, to one half times the window head height, the provision aligns with the sidelit zone dimension of other energy codes. The changes will simplify applicaitn and enforcement throught consistent sidelit zone dimensining across energy codes. In many cases, the sidelit daylighting zone area becomes either smaller or larger depending on the head height of the window. The proposed change allows the horizontal dimension beyond the vertical fenestration to dynamically scale based on the amount of daylight entering the space due to vertical fenestration head height instead of being a static two feet which could be too much or not enough distance for daylighting to enter the space.

Cost Impact: The code change proposal will not increase or decrease the cost of construction. Changing the definition of the daylighting area to align with other codes will slightly expand the instances when the sidelit daylighting area will reach the 150W lighting power threshold. As a result, some sidelit daylighting

areas which would not have had to apply the cost of daylighting controls before this change, will now require daylighting controls in the building construction. The benefit for energy efficiency increases in these instances, and the cost effectiveness for the controls remains the same as before this code change. As cited in daylighting research study “Daylighting Analysis for ASHRAE 90.1 Code Development” by PNNL and Heschong Mahone Group, a cost to benefit ratio of 1.2 (1.0 or less is breakeven) is achieved in buildings of average window to wall ratio, averaged climate zones and with visual light transmittance of 0.2.

Proposal # 4442

CE191-19

CE192-19

IECC: C405.2.3.2

Proponent: Jack Bailey, representing International Association of Lighting Designers (jbailey@oneluxstudio.com); Glenn Heinmiller, Lam Partners, representing International Association of Lighting Designers (glenn@lampartners.com)

2018 International Energy Conservation Code

Revise as follows:

C405.2.3.2 Sidelit zone. The sidelit zone is the floor area adjacent to vertical *fenestration* that complies with all of the following:

1. Where the fenestration is located in a wall, the sidelit zone shall extend laterally to the nearest full-height wall, or up to 1.0 times the height from the floor to the top of the fenestration, and longitudinally from the edge of the fenestration to the nearest full-height wall, or up to 2 feet (610 mm), whichever is less, as indicated in Figure C405.2.3.2.
2. The area of the fenestration is not less than 24 square feet (2.23 m²).
3. The distance from the fenestration to any building or geological formation that would block access to daylight is greater than the height from the bottom of the fenestration to the top of the building or geologic formation.
4. The visible transmittance of the fenestration is not less than 0.20.
5. Where the fenestration is shaded by an overhanging projection and the projection factor determined in accordance with Equation 4-5 is not greater than 1.0 for fenestration oriented 45 degrees or less from true north and not greater than 1.5 for all other orientations.

Reason: Currently there is no exception from daylight responsive controls requirements for windows shaded by deep overhangs. This proposal would create an exception, by stating that a daylight zone is not established if the exterior overhang is too deep.

The exception varies based on façade orientation, with a shallower projection required on the north façade than on the east, south, and west. The language proposed here “oriented 45 degrees or less from true north” is very similar to the language in Table C402.4 “oriented within 45 degrees of true north”. We prefer “45 degrees or less” because it is clear how to treat a building façade oriented exactly 45 degrees from true north.

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

Where there is a deep overhanging projection, there will no longer be a requirement to install daylight responsive controls.

Proposal # 4988

CE192-19

CE193-19

IECC: C405.2.3.2, C405.2.3.3, FIGURE C405.2.3.3(2), FIGURE C405.2.3.3(3)

Proponent: Jack Bailey, representing International Association of Lighting Designers (jbailey@oneluxstudio.com); Glenn Heinmiller, Lam Partners, representing International Association of Lighting Designers (glenn@lampartners.com)

2018 International Energy Conservation Code

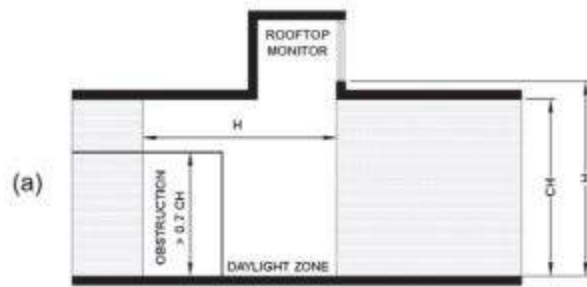
Revise as follows:

C405.2.3.2 Sidelit zone. The sidelit zone is the floor area adjacent to vertical fenestration that complies with all of the following:

1. Where the fenestration is located in a wall, the sidelit zone shall extend laterally to the nearest full-height wall, or up to 1.0 times the height from the floor to the top of the fenestration, and longitudinally from the edge of the fenestration to the nearest full-height wall, or up to 2 feet (610 mm), whichever is less, as indicated in Figure C405.2.3.2.
2. Where the fenestration is located in a rooftop monitor, the sidelit daylight zone shall extend laterally to the nearest obstruction that is taller than 0.7 times the ceiling height, or up to 1.0 times the height from the floor to the bottom of the fenestration, whichever is less, and longitudinally from the edge of the fenestration to the nearest obstruction that is taller than 0.7 times the ceiling height, or up to 0.25 times the height from the floor to the bottom of the fenestration, whichever is less, as indicated in Figures C405.2.3.2 (1) and C405.2.3.2(2).
3. The area of the fenestration is not less than 24 square feet (2.23 m²).
4. The distance from the fenestration to any building or geological formation that would block access to daylight is greater than the height from the bottom of the fenestration to the top of the building or geologic formation.
5. The visible transmittance of the fenestration is not less than 0.20.

C405.2.3.3 Toplit zone. The toplit zone is the floor area underneath a roof fenestration assembly that complies with all of the following:

1. The toplit zone shall extend laterally and longitudinally beyond the edge of the roof fenestration assembly to the nearest obstruction that is taller than 0.7 times the ceiling height, or up to 0.7 times the ceiling height, whichever is less, as indicated in Figure C405.2.3.3(1).
2. ~~Where the fenestration is located in a rooftop monitor, the toplit zone shall extend laterally to the nearest obstruction that is taller than 0.7 times the ceiling height, or up to 1.0 times the height from the floor to the bottom of the fenestration, whichever is less, and longitudinally from the edge of the fenestration to the nearest obstruction that is taller than 0.7 times the ceiling height, or up to 0.25 times the height from the floor to the bottom of the fenestration, whichever is less, as indicated in Figures C405.2.3.3(2) and C405.2.3.3(3).~~
3. Direct sunlight is not blocked from hitting the roof fenestration assembly at the peak solar angle on the summer solstice by buildings or geological formations.
4. The product of the visible transmittance of the roof fenestration assembly and the area of the rough opening of the roof fenestration assembly divided by the area of the toplit zone is not less than 0.008.



(a) Section view
(b) Plan view of daylight zone under a rooftop monitor

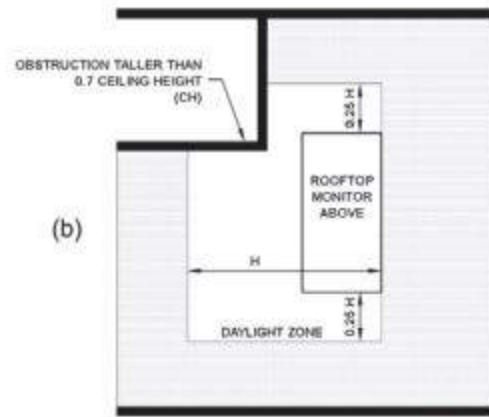


FIGURE C405.2.3.3 C405.2.3.2(2.1)
DAYLIGHT ZONE UNDER A ROOFTOP MONITOR

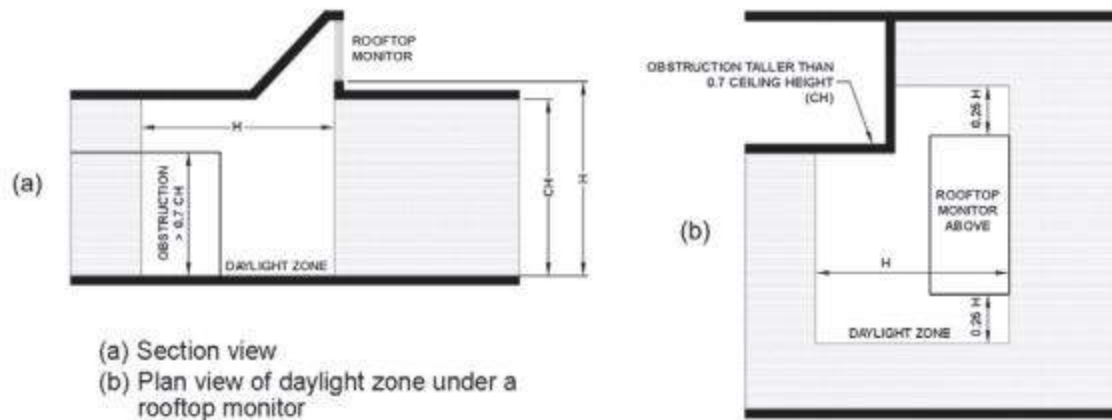


FIGURE C405.2.3.3 C405.2.3.2(3 2)
DAYLIGHT ZONE UNDER A SLOPED ROOFTOP MONITOR

Reason: The language describing daylight zones under rooftop monitors was relocated from the “sidelit” to the “toplit” section in the 2018 IECC. This was a mistake. The requirements for overshadowing, VT, and fenestration area in the toplit section cannot be sensibly applied to rooftop monitors, and were never intended to be applied to rooftop monitors. By contrast, the requirements for overshadowing, VT, and fenestration area in the sidelit section are applicable.

This proposal also clarifies that “vertical fenestration” is a defined term, by adding italics. For rooftop monitors with sloped glazing, this definition is beneficial because it creates a clear distinction between a “rooftop monitor” and a skylight (i.e. a “rooftop monitor” has vertical fenestration which, by definition, is “installed at a slope of not less than 60 degrees from the horizontal”).

Cost Impact: The code change proposal will not increase or decrease the cost of construction. This proposed change is a clarification of code intent.

Proposal # 4786

CE193-19

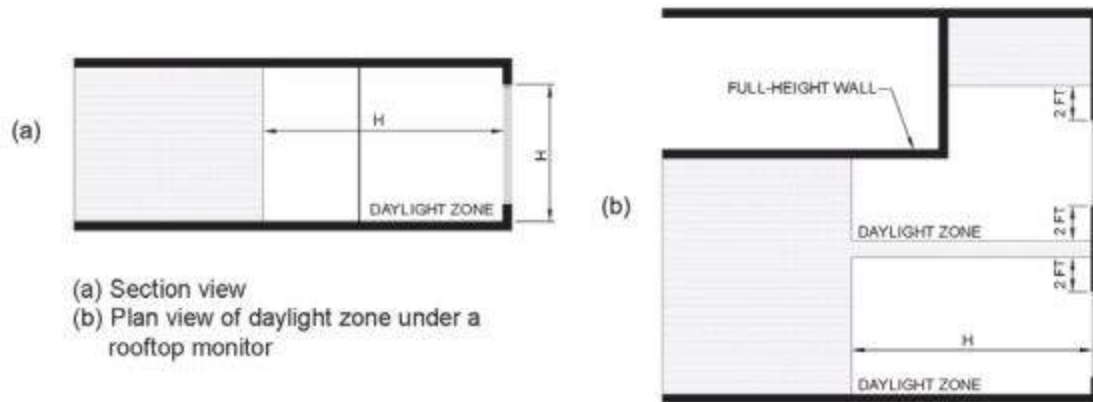
CE194-19

IECC: FIGURE C405.2.3.2

Proponent: Marilyn Williams, representing National Electrical Manufacturers Association
(mar_williams@nema.org)

2018 International Energy Conservation Code

Revise as follows:



~~(b) Plan view of daylight zone under a rooftop monitor~~

(b) Plan view

**FIGURE C405.2.3.2
SIDELIT ZONE**

Reason: Editorial change to correct mis-label of daylighting sidelit zone figure.

Cost Impact: The code change proposal will not increase or decrease the cost of construction
There is no cost impact. This change is editorial.

Proposal # 4396

CE194-19

CE195-19

IECC: C405.2.3.2

Proponent: Marilyn Williams, representing National Electrical Manufacturers Association
(mar_williams@nema.org)

2018 International Energy Conservation Code

Revise as follows:

C405.2.3.2 Sidelit zone. The sidelit zone is the floor area adjacent to vertical *fenestration* that complies with all of the following:

1. Where the fenestration is located in a wall, the sidelit zone shall extend laterally to the nearest full-height wall, or up to 1.0 times the height from the floor to the top of the fenestration, and longitudinally from the edge of the fenestration to the nearest full-height wall, or up to 2 feet (610 mm), whichever is less, as indicated in Figure C405.2.3.2.
2. The area of the fenestration is not less than 24 square feet (2.23 m²).
3. The distance from the fenestration to any building or geological formation that would block *access to daylight* is greater than the height from the bottom of the fenestration to the top of the building or geologic formation.
4. The visible transmittance of the fenestration is not less than 0.20.
5. For fenestration shaded by an overhang projection with vertical fenestration above the projection, the projection factor, as determined in accordance with Equation 4-5 in Section C402.4.3, is not greater than 1.0 for fenestration oriented less than 45 degrees from North and not greater than 1.5 for all other orientations.

Reason: Revising this language will:

1. Clarify how a daylighting sidelit zone is determined when there is an overhang or shading projection associated with the sidelit zone vertical fenestrations.
2. Eliminate daylighting sidelit zones where adequate daylight is not available to justify daylight responsive controls installation.
3. Increase code interpretation simplicity for sidelit daylight zones.

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

Where there is an overhang of adequate projection factor (PF), it will not be required to install daylight responsive controls.

Proposal # 4389

CE195-19

CE196-19

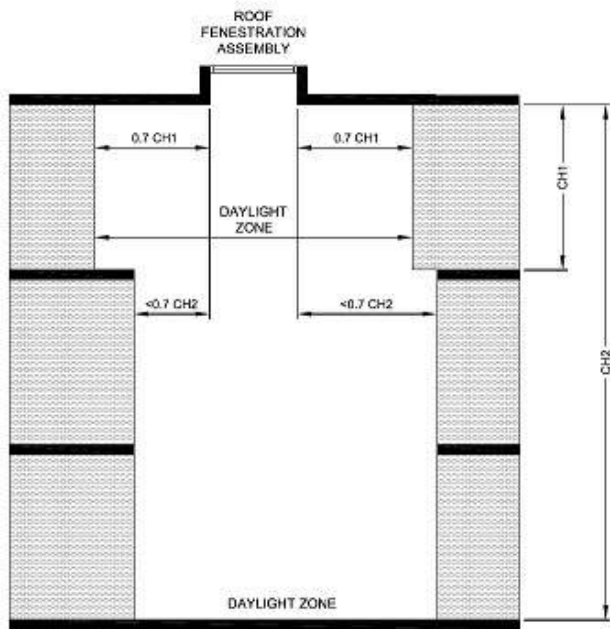
IECC: C405.2.3.4(New) Figure C405.2.3.4(New)

Proponent: Jack Bailey, representing International Association of Lighting Designers (jbailey@oneluxstudio.com); Glenn Heinmiller, Lam Partners, representing International Association of Lighting Designers (glenn@lampartners.com)

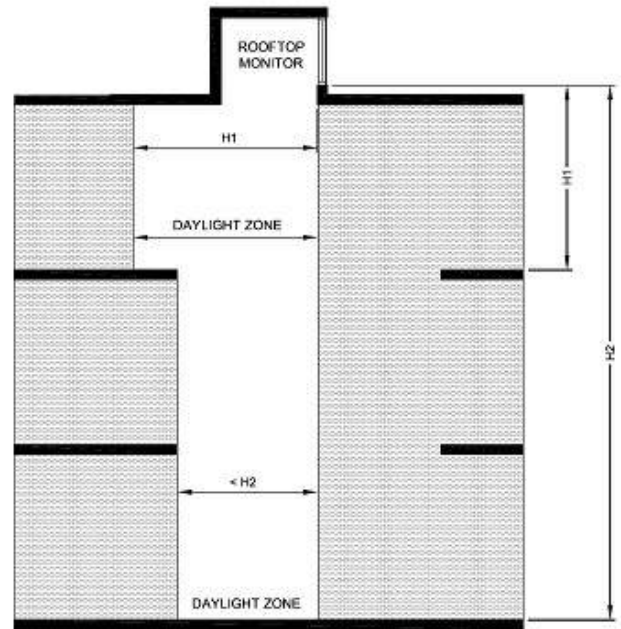
2018 International Energy Conservation Code

Add new text as follows:

C405.2.3.4 Atriums Daylight zones at atrium spaces shall be established at the top floor surrounding the atrium and at the floor of the atrium space, and not on intermediate floors, as indicated in Figure C405.2.3.4.



(a) Section view of roof fenestration assembly at atrium



(b) Section view of rooftop monitor at atrium

FIGURE C405.2.3.4
DAYLIGHT ZONES AT A MULTISTORY ATRIUM

Reason: Currently the code provides no guidance as to how daylight zones would be established in multistory atrium spaces. This proposal provides clarity.

It seems reasonable that roof-mounted fenestration would not establish daylight zones on intermediate floors of an atrium, because of shadowing from each floor slab onto the floor below.

Cost Impact: The code change proposal will not increase or decrease the cost of construction. This proposed change is a clarification.

Proposal # 4787

CE196-19

CE197-19

IECC: C405.2.6, C405.2.6.2

Proponent: Jack Bailey, representing International Association of Lighting Designers (jbailey@oneluxstudio.com); Glenn Heinmiller, Lam Partners, representing International Association of Lighting Designers (glenn@lampartners.com)

2018 International Energy Conservation Code

Revise as follows:

C405.2.6 Exterior lighting controls. Exterior lighting systems shall be provided with controls that comply with Sections C405.2.6.1 through C405.2.6.4. ~~Decorative lighting systems shall comply with Sections C405.2.6.1, C405.2.6.2 and C405.2.6.4.~~

Exceptions:

1. Lighting for covered vehicle entrances and exits from buildings and parking structures where required for eye adaptation.
2. Lighting controlled from within dwelling units.

C405.2.6.2 ~~Decorative lighting shutoff.~~ Building facade and landscape lighting. Building facade and landscape lighting shall automatically shut off from not later than 1 hour after business closing to not earlier than 1 hour before business opening.

Reason: The use of the term “decorative” lighting for exterior applications is confusing. We have interior “decorative” lighting described in CC405.3.2.2.1, but no exterior “decorative” lighting. The requirements of Section C405.2.6.2 refer specifically to building façade and landscape lighting, and these are the terms we should use.

The second sentence in C405.2.6 is not necessary, as it has no effect.

Cost Impact: The code change proposal will not increase or decrease the cost of construction
This is an editorial clarification.

Proposal # 4789

CE197-19

CE198-19

IECC: C405.2.6.3

Proponent: Connor Barbaree, representing ASHRAE (cbarbaree@ashrae.org)

2018 International Energy Conservation Code

Revise as follows:

C405.2.6.3 Lighting setback. Lighting that is not controlled in accordance with Section C405.2.6.2 shall ~~be~~ comply with the following:

1. Be controlled so that the total wattage of such lighting is automatically reduced by not less than 50 percent by selectively switching off or dimming luminaires at one of the following times:
 - ~~1.~~ 1.1. From not later than midnight to not earlier than 6 a.m.
 - ~~2.~~ 1.2. From not later than one hour after business closing to not earlier than one hour before business opening.
 - ~~3.~~ 1.3. During any time where activity has not been detected for 15 minutes or more.
2. Luminaires serving outdoor parking areas and having a rated input wattage of greater than 78 W and a mounting height of 24 feet or less above the ground shall be controlled so that the total wattage of such lighting is automatically reduced by not less than 50 percent during any time where activity has not been detected for 15 minutes or more. No more than 1500 W of lighting power shall be controlled together.

Reason: Parking lot lighting offers more controllability and energy efficiency through the prolific use of solid state light sources. In prior versions of the IECC, the lighting setback control to reduce lighting wattage was limited to just 30% due to legacy lighting source limitations. Solid state lighting sources now allow a greater control range and dimmability of exterior luminaires than in the past. Changing the wattage reduction from 30 to 50% maintains sufficient exterior illumination after business operating hours when occupancy is reduced, yet is able to save an additional 20% in lighting wattage over the prior IECC versions. A 50% lighting setback wattage reduction has been part of other energy codes for a number of years. This change allows the IECC to remain consistent with the practice and efficiency of other codes.

Providing lighting when it is needed, through activity detection, has been long proven as one of the most efficient and effective ways to control lighting. In outdoor environments, as parking lots, detection technology is widely available. Many outdoor luminaires come with options to include detection technology directly integrated in the luminaire. These controls add some cost to the parking lot luminaires, but offer good payback. The amount of occupancy in parking lots ranges by exterior use type. Office building exteriors show 29% occupancy (using the proposed 15 minute time delay) during normally scheduled occupancy of 6pm to midnight. This allows lighting that might normally be at 100% to be reduced to 50% for 71% of the time, when controlled by activity detection. By comparison, an outdoor shopping center experiences a 79% occupancy. Even with this broad range of exterior occupancy rates, there still remains consider opportunity to reduce the lighting level with minimal impact to use.

Bibliography: Nonresidential Outdoor Lighting Controls, Codes and Standards Enhancement Initiative, Measure Number: 2019-NR-LIGHT3F, September 2017
Use of Occupancy Sensors in LED Parking Lot and Garage Applications: Early Experiences, Gateway Demonstrations, U.S. Department of Energy, Prepared by: Pacific Northwest National Laboratories, October 2012

Outdoor Lighting and Controls, Codes and Standards Enhancement Initiative, California Utilities Statewide Codes and Standards Team, October 2011

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

This proposal increases the cost of construction due to the lighting controls needed for this requirement. This proposed change increases energy efficiency by an additional 20% during after hour periods and when there is no occupancy in the occupancy sensor-controlled area and provides payback for the increased cost of construction.

Proposal # 4855

CE198-19

CE199-19

IECC: C405.2.7 (New)

Proponent: Marilyn Williams, representing National Electrical Manufacturers Association
(mar_williams@nema.org)

2018 International Energy Conservation Code

Add new text as follows:

C405.2.7 Parking Garage Lighting Control. Lighting for parking garage shall comply with the following:

1. Parking garage lighting shall have automatic time-switch shutoff in accordance with Section C405.2.2.1.
2. Lighting power of each luminaire shall be automatically reduced by not less than 30% when there is no activity detected within a lighting zone for 20 minutes. Lighting zones for this requirement shall be no larger than 3600 ft².
3. Where lighting for eye adaptation is provided at covered vehicle entrances and exits from buildings and parking structures, such lighting shall be separately controlled by a device that automatically reduces lighting power by at least 50% from sunset to sunrise.
4. The power to luminaires within 30 ft of perimeter wall openings or fenestration shall automatically reduce in response to daylight by at least 50%.

Exceptions:

1. Where the opening or fenestration-to-wall-ratio is less than 40% as viewed from the interior and encompassing the vertical distance from the driving surface to the lowest structural element.
2. Where the distance from the opening or fenestration to any exterior daylight blocking obstruction is less than one-half the height from the bottom of the opening or fenestration to the top of the obstruction.
3. Where openings are obstructed by permanent screens or architectural elements restricting daylight entering the interior space.

Reason: Adding this language will:

1. Reduce inconsistency and confusion with the application of lighting controls in parking garages.
2. Align code language and implementation with other energy efficiency codes.
3. Reduce energy use.
4. Resolve compliance in application and inspection.

Currently there is confusion on how to apply the requirements of the 2018 IECC to parking garage applications. Is it to be treated as a interior space, and if so, how are the control requirements applied that has different use needs that building interior spaces? The Daylight Responsive Controls of section C405.2.3 do not provide proper guidance for how to control lighting in a parking garage setting. This proposal provides proper daylight responsive control and exceptions that meet the design needs and operation of parking garages.

There is some relative increase in cost due to adding occupancy sensing control to reduce the lighting level when there is no activity in controlled lighting zones.

Adding a parking garage specific control section, there is improved clarity in parking garage application, increased energy efficiency in lighting operation and better compliance through requirements that meetg the application needs of parking garages.

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

The code change proposal will increase the cost of construction. Proposed language is mostly a clarification and editorial in nature. There is a small increase in construction cost with the added controls for partial automatic off that provide a payback during the long operating hours of a parking garage structure.

Proposal # 4400

CE199-19

CE200-19

IECC: C405.3, C405.4

Proponent: Jack Bailey, representing International Association of Lighting Designers (jbailey@oneluxstudio.com); Glenn Heinmiller, Lam Partners, representing International Association of Lighting Designers (glenn@lampartners.com)

2018 International Energy Conservation Code

Revise as follows:

C405.3 Interior lighting power requirements (Prescriptive). A building complies with this section where its total connected interior lighting power calculated under Section C405.3.1 is not greater than the interior lighting power allowance calculated under Section C405.3.2. For the purposes of this determination, all building floor area which is under the horizontal projection of the roof or floor above shall be considered interior, and all lighting serving that floor area shall be considered interior lighting.

C405.4 Exterior lighting power requirements (Mandatory). The total connected exterior lighting power calculated in accordance with Section C405.4.1 shall be not greater than the exterior lighting power allowance calculated in accordance with Section C405.4.2. For the purposes of this determination, all building floor area which is not under the horizontal projection of the roof or floor above shall be considered exterior, and all lighting serving that floor area shall be considered exterior lighting.

Reason: Under the current code how do we know whether lighting is “interior” or “exterior”? This is not discussed anywhere in the code, so users are currently free to make their own assumptions. Consider these examples:

1. Unenclosed lobbies, corridors, and retail and airport concourses in milder climates are most often considered “interior” spaces if they are under a roof, even though they are not conditioned.
2. Lower floors of open air parking garages are considered “interior” spaces (and the allowance for these is located in the interior lighting power tables C405.3.2(1) and C405.3.2(2).
3. The roof of a parking garage is considered “exterior” space, and the allowance for this is located in the exterior lighting power table C405.4.2(2).
4. Rooftop terraces are most often considered “exterior” even though this is occupiable building floor area.
5. Spaces under trellises and canopies on building sites are most often considered exterior.
6. Rooftop terraces and open air courtyards are most often considered exterior.

The proper classification of lighting is important for both lighting power and controls determinations under the code.

Any proposal on this subject matter is bound to challenge some people’s assumptions about how lighting should be classified, and this is inevitable when we try to bring everyone to a common understanding of this topic. It is also inevitable that some of the determinations will seem arbitrary.

The proposed language “under the horizontal projection of the roof or floor above” is borrowed from the IBC definition of “gross floor area” which uses similar language:

From the 2018 IBC:

[BE] FLOOR AREA, GROSS. The floor area within the inside perimeter of the exterior walls of the building under consideration, exclusive of vent shafts and courts, without deduction for corridors, stairways, ramps, closets, the thickness of interior walls, columns or other features. The floor area of a building, or portion thereof,

not provided with surrounding exterior walls shall be the usable area under the horizontal projection of the roof or floor above. The gross floor area shall not include shafts with no openings or interior courts.

This proposal is clear, and should align the language of the code with the way it is most often interpreted for the most common applications.

Cost Impact: The code change proposal will not increase or decrease the cost of construction
This aligns the text of the code with the way it is most often applied.

Proposal # 4791

CE200-19

CE201-19

IECC: C405.3.1

Proponent: Marilyn Williams, representing National Electrical Manufacturers Association
(mar_williams@nema.org)

2018 International Energy Conservation Code

Revise as follows:

C405.3.1 Total connected interior lighting power. The total connected interior lighting power shall be determined in accordance with Equation 4-10.

$$TCLP = [LVL + BLL + LED + TRK + Other]$$

(Equation 4-10)

where:

TCLP = Total connected lighting power (watts).

LVL = For luminaires with lamps connected directly to building power, such as line voltage lamps, the rated wattage of the lamp.

BLL = For luminaires incorporating a ballast or transformer, the rated input wattage of the ballast or transformer when operating that lamp.

LED = For light-emitting diode luminaires with either integral or remote drivers, the rated wattage of the luminaire.

TRK = For lighting track, cable conductor, rail conductor, and plug-in busway systems that allow the addition and relocation of luminaires without rewiring, the wattage shall be one of the following:

1. The specified wattage of the luminaires, but not less than 8 W per linear foot (25 W/lin m).
2. The wattage limit of the permanent current-limiting devices protecting the system.
3. The wattage limit of the transformer supplying the system.

Other = The wattage of all other luminaires and lighting sources not covered previously and associated with interior lighting verified by data supplied by the manufacturer or other *approved* sources.

The connected power associated with the following lighting equipment and applications is not included in calculating total connected lighting power.

1. Television broadcast lighting for playing areas in sports arenas.
2. Emergency lighting automatically off during normal building operation.
3. Lighting in spaces specifically designed for use by occupants with special lighting needs, including those with visual impairment and other medical and age-related issues.
4. Casino gaming areas.
5. Mirror lighting in dressing rooms.
6. Task lighting for medical and dental purposes that is in addition to general lighting and controlled by an independent control device.
7. Display lighting for exhibits in galleries, museums and monuments that is in addition to general lighting and controlled by an independent control device.

8. Lighting for theatrical purposes, including performance, stage, film production and video production.
9. Lighting for photographic processes.
10. Lighting integral to equipment or instrumentation and installed by the manufacturer.
11. Task lighting for plant growth or maintenance.
12. Advertising signage or directional signage.
13. Lighting for food warming.
14. Lighting equipment that is for sale.
15. Lighting demonstration equipment in lighting education facilities.
16. Lighting approved because of safety considerations.
17. Lighting in retail display windows, provided that the display area is enclosed by ceiling-height partitions.
18. Furniture-mounted supplemental task lighting that is controlled by automatic shutoff.
19. Exit signs.
20. Antimicrobial lighting used for the sole purpose of disinfecting a space.

Reason: One traditional type of indoor connected power exemptions has been the use of lighting for non-human, non-visual applications as exemplified by food warming or plant growth. New technology is emerging for another non-human, non-visual application using narrow-wavelength high density violet light just above 400 nm to disinfect a space by eliminating a range of common pathogens susceptible to this band. Lighting developed specifically for this purpose is on during times of vacancy and off during occupancy. This type of application is not only important in medical facilities but can also be used in locker rooms, restrooms, and kitchen areas to improve the general health and well being of those in a space.

Without a directly defined exemption, this new technology for improving the general health could come into conflict with today's energy codes, depending on interpretation.

Cost Impact: The code change proposal will not increase or decrease the cost of construction. The code change proposal will neither increase or decrease the cost of construction. No cost impact to the normally specified architectural lighting installation with a space. Customers looking for this type of implementation would buy separate of specified architectural lighting.

Proposal # 4549

CE201-19

CE202-19

IECC: C405.3.2, C405.3.2.2

Proponent: Glenn Heinmiller, Lam Partners, representing Self (glenn@lampartners.com); Jack Bailey, representing International Association of Lighting Designers (jbailey@oneluxstudio.com)

2018 International Energy Conservation Code

Revise as follows:

C405.3.2 Interior lighting power allowance. The total interior lighting power allowance (watts) is determined according to Table C405.3.2(1) using the Building Area Method, or Table C405.3.2(2) using the Space-by-Space Method, for all areas of the building covered in this permit. Buildings with unfinished spaces shall use the Space-by-Space Method.

C405.3.2.2 Space-by-Space Method. For the Space-by-Space Method, the interior lighting power allowance is determined by multiplying the floor area of each space times the value for the space type in Table C405.3.2(2) that most closely represents the proposed use of the space, and then summing the lighting power allowances for all spaces. Where a building has unfinished spaces, the lighting power allowance for the unfinished spaces shall be the total connected lighting power for those spaces, or 0.2 watts per square foot, whichever is less. Tradeoffs among spaces are permitted.

Reason: This proposal clarifies how the lighting power allowance is to be determined for Core and Shell buildings. This is the source of much legitimate confusion. While there are a variety of strategies for permitting and obtaining certificate of occupancy in core and shell buildings with unfinished spaces, we are concerned about one scenario in particular: where tenant spaces are provided with minimal lighting to meet the egress requirements of the IBC so that a permit can be "closed out", with the intention that this lighting will be replaced when a tenant leases the space and does their own fitout with permanent lighting. In these situations it is quite easy to "game" the code by taking an allowance for the intended use of the space (i.e. retail, office, etc.) while only counting the minimal lighting that is installed to obtain a certificate of occupancy. This is a major loophole.

This change requires that the space-by-space method be used for buildings with unfinished spaces. The Building Area Method cannot be used in this case because the power allowances for each Building Area Type are based on the allocation of space types in a typical building of that building type (Office, Retail, etc.) and it is assumed that all spaces are finished. The space-by-space method is the only way to break out the unfinished spaces and assign a power allowance for those spaces.

The proposed language will be clear in all instances, and will prevent people from claiming credit for fictitious savings in lighting power in unfinished spaces.

Cost Impact: The code change proposal will not increase or decrease the cost of construction. This proposal provides clarity on the application of the code and closes a potential loophole.

Proposal # 4790

CE202-19

CE203-19

IECC: C405.3.2, C405.3.2.1, C405.3.2.2

Proponent: Glenn Heinmiller, Lam Partners, representing International Association of Lighting Designers (glenn@lampartners.com); Jack Bailey (jbailey@oneluxstudio.com)

2018 International Energy Conservation Code

Revise as follows:

C405.3.2 Interior lighting power allowance. The total interior lighting power allowance (watts) ~~is for an entire building shall be determined according to Table C405.3.2(1) using the C405.3.2.1 Building Area Method, or Table C405.3.2(2) using the Space-by-Space Method, for all areas of the building covered in this permit.~~
C405.3.2.2 Space-by-Space method. The interior lighting power allowance for projects that only involve portions of a building shall be determined according C405.3.2.2 Space-by-Space Method.

Delete and substitute as follows:

~~**C405.3.2.1 Building Area Method.** For the Building Area Method, the interior lighting power allowance is the floor area for each building area type listed in Table C405.3.2(1) times the value from Table C405.3.2(1) for that area. For the purposes of this method, an "area" shall be defined as all contiguous spaces that accommodate or are associated with a single building area type, as listed in Table C405.3.2(1). Where this method is used to calculate the total interior lighting power for an entire building, each building area type shall be treated as a separate area.~~

C405.3.2.1 Building Area Method. For the Building Area Method, the interior lighting power allowance is calculated as follows:

1. For each building area type inside the building, determine the applicable building area type and the allowed lighting power density for that type from Table C405.3.2(1). For building area types not listed, select the building area type that most closely represents the use of that area. For the purposes of this method, an "area" shall be defined as all contiguous spaces that accommodate or are associated with a single building area type.
2. Determine the floor area for each building area type listed in Table C405.3.2(1) and multiply this area by the applicable value from Table C405.3.2(1) to determine the lighting power (watts) for each building area type.
3. The total interior lighting power allowance (watts) for the entire *building* is the sum of the lighting power from each building area type.

~~**C405.3.2.2 Space-by-Space Method.** For the Space-by-Space Method, the interior lighting power allowance is determined by multiplying the floor area of each space times the value for the space type in Table C405.3.2(2) that most closely represents the proposed use of the space, and then summing the lighting power allowances for all spaces. Tradeoffs among spaces are permitted.~~

C405.3.2.2 Space-by-Space Method. For the Space by-Space Method, the interior lighting power allowance is calculated as follows:

1. For each space enclosed by partitions that are not less than 80 percent of the ceiling height, determine the applicable space type from Table C405.3.2(2). For space types not listed, select the space type that most closely represents the proposed use of the space. Where a space has multiple functions, that space may be divided into separate spaces.
2. Determine the total floor area of all the spaces of each space type and multiply by the value for the space type in Table C405.3.2(2) to determine the lighting power (watts) for each space type.

3. The total interior lighting power allowance (watts) shall be the sum of the lighting power allowances for all space types.

Reason: This proposal clarifies the application and calculation procedures for the Building Area Method and the Space-by-Space Method. Currently the code does not provide clear or complete direction. There is no change in stringency.

This proposal specifically clarifies these items which have been a source of confusion and misunderstanding:

- The Building Area Method may only be used to determine compliance for an entire building. This is because the Building Area method power allowances are based on the typical mix of space types within an entire building of that building type.
- The Space-by-Space Method does not require the determination of the area and power of each individual space, but rather the total area and total power for all of the spaces of each space type.

This proposal makes this calculation procedure easier to understand and will increase the usability of the code. Codes which are usable are more likely to be complied with and are easier to enforce.

Cost Impact: The code change proposal will not increase or decrease the cost of construction. This proposal is a re-write to clarify code requirements.

Proposal # 4616

CE203-19

CE204-19

IECC: TABLE C405.3.2(1), TABLE C405.3.2(2)

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

2018 International Energy Conservation Code

Revise as follows:

TABLE C405.3.2(1)
INTERIOR LIGHTING POWER ALLOWANCES: BUILDING AREA METHOD

BUILDING AREA TYPE	LPD (w/ft ²)
Automotive facility	0.74 <u>64</u>
Convention center	0.76 <u>70</u>
Courthouse	0.90 <u>74</u>
Dining: bar lounge/leisure	0.90 <u>69</u>
Dining: cafeteria/fast food	0.79 <u>66</u>
Dining: family	0.78 <u>61</u>
Dormitory ^{a, b}	0.64 <u>52</u>
Exercise center	0.65
Fire station ^a	0.53 <u>50</u>
Gymnasium	0.68 <u>67</u>
Health care clinic	0.82 <u>68</u>
Hospital ^a	1.05 <u>0.86</u>
Hotel/Motel ^{a, b}	0.75 <u>70</u>
Library	0.78
Manufacturing facility	0.90 <u>60</u>
Motion picture theater	0.83 <u>62</u>
Multifamily ^c	0.68 <u>49</u>
Museum	1.06 <u>0.68</u>
Office	0.79 <u>69</u>
Parking garage	0.15 <u>12</u>
Penitentiary	0.75 <u>67</u>
Performing arts theater	1.18 <u>0.85</u>
Police station	0.80 <u>68</u>
Post office	0.67 <u>62</u>
Religious building	0.94 <u>72</u>
Retail	1.06 <u>0.91</u>
School/university	0.84 <u>67</u>
Sports arena	0.87 <u>76</u>
Town hall	0.80 <u>72</u>

Transportation	0.61 <u>51</u>
Warehouse	0.48 <u>41</u>
Workshop	0.90 <u>83</u>

- a. Where sleeping units are excluded from lighting power calculations by application of Section R405.1, neither the area of the sleeping units nor the wattage of lighting in the sleeping units is counted.
- b. Where dwelling units are excluded from lighting power calculations by application of Section R405.1, neither the area of the dwelling units nor the wattage of lighting in the dwelling units is counted.
- c. Dwelling units are excluded. Neither the area of the dwelling units nor the wattage of lighting in the dwelling units is counted.

TABLE C405.3.2(2)
INTERIOR LIGHTING POWER ALLOWANCES: SPACE-BY-SPACE METHOD

COMMON SPACE TYPES ^a	LPD (watts/sq.ft)
Atrium	
Less than 40 feet in height	0.03 <u>23</u> per foot in total height
Greater than 40 feet in height	0.40 + 0.02 per foot in total height
Audience seating area	
In an auditorium	0.63
In a convention center	0.82 <u>65</u>
In a gymnasium	0.65 <u>43</u>
In a motion picture theater	1.14 <u>0.64</u>
In a penitentiary	0.28
In a performing arts theater	2.03 <u>1.34</u>
In a religious building	1.53 <u>0.98</u>
In a sports arena	0.43 <u>42</u>
Otherwise	0.43 <u>40</u>
Banking activity area	0.86 <u>79</u>
Breakroom (See Lounge/breakroom)	
Classroom/lecture hall/training room	
In a penitentiary	1.34 <u>06</u>
Otherwise	0.96 <u>74</u>
Computer room	1.33 <u>16</u>
Conference/meeting/multipurpose room	1.07 <u>0.93</u>
<u>Confinement cells</u>	<u>0.52</u>
Copy/print room	0.56 <u>50</u>
Corridor	
In a facility for the visually impaired (and not used primarily by the staff) ^b	0.92 <u>81</u>
In a hospital	0.92 <u>81</u>
In a manufacturing facility	0.29 <u>28</u>

In a primary or secondary school (and not used by staff)	<u>0.74</u>
Otherwise	<u>0.66</u> <u>58</u>
Courtroom	<u>1.39</u> <u>06</u>
Dining area	
In bar/lounge or leisure dining	<u>0.93</u> <u>62</u>
In cafeteria or fast food dining	<u>0.63</u> <u>53</u>
In a facility for the visually impaired (and not used primarily by the staff) ^b	<u>2.00</u> <u>1.48</u>
In family dining	<u>0.71</u> <u>54</u>
In a penitentiary	<u>0.96</u> <u>72</u>
Otherwise	<u>0.63</u> <u>53</u>
Electrical/mechanical room	<u>0.43</u> <u>39</u>
Emergency vehicle garage	0.41
Food preparation area	<u>1.06</u> <u>0.92</u>
Guestroom ^{c, d}	<u>0.77</u> <u>75</u>
Laboratory	
In or as a classroom	<u>1.20</u> <u>04</u>
Otherwise	<u>1.45</u> <u>32</u>
Laundry/washing area	0.43
Loading dock, interior	<u>0.58</u> <u>51</u>
Lobby	
For an elevator	<u>0.68</u> <u>52</u>
In a facility for the visually impaired (and not used primarily by the staff) ^b	2.03
In a hotel	<u>1.06</u> <u>0.68</u>
In a motion picture theater	<u>0.45</u> <u>38</u>
In a performing arts theater	<u>1.70</u> <u>0.82</u>
Otherwise	<u>1.0</u> <u>0.90</u>
Locker room	<u>0.48</u> <u>45</u>
Lounge/breakroom	
In a healthcare facility	<u>0.78</u> <u>53</u>
Otherwise	<u>0.62</u> <u>44</u>
Office	
Enclosed	<u>0.93</u> <u>85</u>
Open plan	<u>0.81</u> <u>78</u>
Parking area, interior	<u>0.14</u> <u>11</u>
Pharmacy area	<u>1.34</u> <u>23</u>
Restroom	
In a facility for the visually impaired (and not used primarily by the staff) ^b	<u>0.96</u> <u>81</u>
Otherwise	<u>0.85</u> <u>75</u>
Sales area	<u>1.22</u> <u>06</u>
Seating area, general	<u>0.42</u> <u>38</u>

Stairway (see Space containing stairway)	
Stairwell	0.58 <u>50</u>
Storage room	0.46 <u>43</u>
Vehicular maintenance area	0.56 <u>53</u>
Workshop	1.14 <u>09</u>
BUILDING TYPE SPECIFIC SPACE TYPES ^a	LPD (watts/sq.ft)
Automotive (see Vehicular maintenance area)	
Convention Center—exhibit space	0.88 <u>69</u>
Dormitory—living quarters ^{c, d}	0.54 <u>46</u>
Facility for the visually impaired ^b	
In a chapel (and not used primarily by the staff)	1.06 <u>0.89</u>
In a recreation room (and not used primarily by the staff)	1.80 <u>53</u>
Fire Station—sleeping quarters ^c	0.20 <u>19</u>
Gymnasium/fitness center	
In an exercise area	0.50
In a playing area	0.82 <u>75</u>
Healthcare facility	
In an exam/treatment room	1.68 <u>16</u>
In an imaging room	1.06 <u>0.98</u>
In a medical supply room	0.54
In a nursery	1.00 <u>0.94</u>
In a nurse's station	0.81 <u>75</u>
In an operating room	2.17 <u>1.87</u>
In a patient room ^c	0.62 <u>45</u>
In a physical therapy room	0.84
In a recovery room	1.03 <u>0.89</u>
Library	
In a reading area	0.82 <u>77</u>
In the stacks	1.20
Manufacturing facility	
In a detailed manufacturing area	0.93 <u>86</u>
In an equipment room	0.65 <u>61</u>
In an extra-high-bay area (greater than 50' floor-to-ceiling height)	1.05 <u>0.73</u>
In a high-bay area (25-50' floor-to-ceiling height)	0.75 <u>58</u>
In a low-bay area (less than 25' floor-to-ceiling height)	0.96 <u>61</u>
Museum	
In a general exhibition area	1.05 <u>0.61</u>
In a restoration room	0.85 <u>77</u>
Performing arts theater—dressing room	0.36 <u>35</u>
Post office—sorting area	0.68 <u>66</u>

Religious buildings	
In a fellowship hall	0.55 <u>54</u>
In a worship/pulpit/choir area	1.53 <u>0.98</u>
Retail facilities	
In a dressing/fitting room	0.50 <u>49</u>
In a mall concourse	0.90 <u>79</u>
Sports arena—playing area	
For a Class I facility ^e	2.47 <u>26</u>
For a Class II facility ^f	1.96 <u>45</u>
For a Class III facility ^g	1.70 <u>08</u>
For a Class IV facility ^h	1.13 <u>0.72</u>
Transportation facility	
In a baggage/carousel area	0.45 <u>40</u>
In an airport concourse	0.31
At a terminal ticket counter	0.62 <u>48</u>
Warehouse—storage area	
For medium to bulky, palletized items	0.35 <u>27</u>
For smaller, hand-carried items	0.69 <u>65</u>

- a. In cases where both a common space type and a building area specific space type are listed, the building area specific space type shall apply
- b. A 'Facility for the Visually Impaired' is a facility that is licensed or will be licensed by local or state authorities for senior long-term care, adult daycare, senior support or people with special visual needs.
- c. Where sleeping units are excluded from lighting power calculations by application of Section R405.1, neither the area of the sleeping units nor the wattage of lighting in the sleeping units is counted.
- d. Where dwelling units are excluded from lighting power calculations by application of Section R405.1, neither the area of the dwelling units nor the wattage of lighting in the dwelling units is counted.
- e. Class I facilities consist of professional facilities; and semiprofessional, collegiate, or club facilities with seating for 5,000 or more spectators.
- f. Class II facilities consist of collegiate and semiprofessional facilities with seating for fewer than 5,000 spectators; club facilities with seating for between 2,000 and 5,000 spectators; and amateur league and high-school facilities with seating for more than 2,000 spectators.
- g. Class III facilities consist of club, amateur league and high-school facilities with seating for 2,000 or fewer spectators.
- h. Class IV facilities consist of elementary school and recreational facilities; and amateur league and high-school facilities without provision for spectators.
- i. The wattage of lighting in daylight transition zones and ramps without parking is excluded
- j. Pool surfaces are excluded. Neither the area of the swimming or spa pool nor the wattage of the lighting serving them is counted.

Reason: This proposal updates the LPD tables in the IECC to reflect advancements in lighting technology and lighting design practices. A majority of these values are from ASHRAE 189.1-2018 but some values were modified based on discussions with lighting designers and other stakeholders as part of the New York Stretch

Code development process. A majority of these changes are driven by how IALD space type definitions have not kept pace with how spaces and lighting needs are evolving. Airport concourses is one such notable examples.

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

This proposal may represent an increase in cost for affected space and building types depending on current practice of the lighting designer and lighting suppliers. Higher efficacy light sources will be required to meet the proposed lighting power densities which may cost more than was is currently used in particular market.

Proposal # 5191

CE204-19

CE205-19

IECC: TABLE C405.3.2(1)

Proponent: Jonathan McHugh, representing McHugh Energy Consultants Inc. (jon@mchughenergy.com)

2018 International Energy Conservation Code

Revise as follows:

TABLE C405.3.2(1)
INTERIOR LIGHTING POWER ALLOWANCES: BUILDING AREA METHOD

BUILDING AREA TYPE	LPD (w/ft²)
Automotive facility	0.71 <u>0.64</u>
Convention center	0.76 <u>0.64</u>
Courthouse	0.90 <u>0.74</u>
Dining: bar lounge/leisure	0.90 <u>0.69</u>
Dining: cafeteria/fast food	0.79 <u>0.66</u>
Dining: family	0.78 <u>0.61</u>
Dormitory ^{a, b}	0.61 <u>0.52</u>
Exercise center	0.65
Fire station ^a	0.53 <u>0.50</u>
Gymnasium	0.68 <u>0.65</u>
Health care clinic	0.82 <u>0.68</u>
Hospital ^a	1.05 <u>0.86</u>
Hotel/Motel ^{a, b}	0.75 <u>0.56</u>
Library	0.78 <u>0.70</u>
Manufacturing facility	0.90 <u>0.60</u>
Motion picture theater	0.83 <u>0.44</u>
Multifamily ^c	0.68 <u>0.45</u>
Museum	1.06 <u>0.55</u>
Office	0.79 <u>0.64</u>
Parking garage	0.15 <u>0.12</u>
Penitentiary	0.75 <u>0.67</u>
Performing arts theater	1.18 <u>0.85</u>
Police station	0.80 <u>0.66</u>
Post office	0.67 <u>0.62</u>
Religious building	0.94 <u>0.67</u>
Retail	1.06 <u>0.84</u>
School/university	0.81 <u>0.65</u>
Sports arena	0.87 <u>0.75</u>
Town hall	0.80 <u>0.69</u>
Transportation	0.61 <u>0.51</u>

Warehouse	0.48 <u>0.41</u>
Workshop	0.90 <u>0.83</u>

- a. Where sleeping units are excluded from lighting power calculations by application of Section R405.1, neither the area of the sleeping units nor the wattage of lighting in the sleeping units is counted.
- b. Where dwelling units are excluded from lighting power calculations by application of Section R405.1, neither the area of the dwelling units nor the wattage of lighting in the dwelling units is counted.
- c. Dwelling units are excluded. Neither the area of the dwelling units nor the wattage of lighting in the dwelling units is counted.

Reason: The results here reflect advances in lighting technology from a number of sources including the New York stretch code, California's Title 24 and ASHRAE 90.1 and 189.1.

Cost Impact: The code change proposal will not increase or decrease the cost of construction. The LPDs here reflect LED technology. Almost all new lighting projects are using LEDs. The costs of LEDs have dropped significantly and the market share of competing technologies has declined. Since some lighting designers "design to code" in some cases this may result in less products being installed for a cost savings.

Proposal # 5650

CE205-19

CE206-19

IECC: TABLE C405.3.2(1)

Proponent: Connor Barbaree, representing ASHRAE (cbarbaree@ashrae.org)

2018 International Energy Conservation Code

Revise as follows:

TABLE C405.3.2(1)
INTERIOR LIGHTING POWER ALLOWANCES: BUILDING AREA METHOD

BUILDING AREA TYPE	LPD (w/ft²)
Automotive facility	0.71 <u>0.75</u>
Convention center	0.76 <u>0.64</u>
Courthouse	0.90 <u>0.79</u>
Dining: bar lounge/leisure	0.90 <u>0.80</u>
Dining: cafeteria/fast food	0.79 <u>0.76</u>
Dining: family	0.78 <u>0.71</u>
Dormitory ^{a, b}	0.61 <u>0.53</u>
Exercise center	0.65 <u>0.72</u>
Fire station ^a	0.53 <u>0.56</u>
Gymnasium	0.68 <u>0.76</u>
Health care clinic	0.82 <u>0.81</u>
Hospital ^a	1.05 <u>0.96</u>
Hotel/Motel ^{a, b}	0.75 <u>0.56</u>
Library	0.78 <u>0.83</u>
Manufacturing facility	0.90 <u>0.82</u>
Motion picture theater	0.83 <u>0.44</u>
Multifamily ^c	0.68 <u>0.45</u>
Museum	1.06 <u>0.55</u>
Office	0.79 <u>0.64</u>
Parking garage	0.15 <u>0.18</u>
Penitentiary	0.75 <u>0.69</u>
Performing arts theater	1.18 <u>0.84</u>
Police station	0.80 <u>0.66</u>
Post office	0.67 <u>0.65</u>
Religious building	0.94 <u>0.67</u>
Retail	1.06 <u>0.84</u>
School/university	0.81 <u>0.72</u>
Sports arena	0.87 <u>0.76</u>
Town hall	0.80 <u>0.69</u>
Transportation	0.61 <u>0.50</u>

Warehouse	0.48 <u>0.45</u>
Workshop	0.90 <u>0.91</u>

- a. Where sleeping units are excluded from lighting power calculations by application of Section R405.1, neither the area of the sleeping units nor the wattage of lighting in the sleeping units is counted.
- b. Where dwelling units are excluded from lighting power calculations by application of Section R405.1, neither the area of the dwelling units nor the wattage of lighting in the dwelling units is counted.
- c. Dwelling units are excluded. Neither the area of the dwelling units nor the wattage of lighting in the dwelling units is counted.

Reason: Building Area Method Lighting Power Densities (LPDs) are based on the Space-by-Space LPDs assigned proportionally for the building type. The LPD values proposed here are a continuation of the extensive work done on the Space-by-Space LPD values. The Space-by-space LPD values are not just an update to existing models, but instead, include an extensive review and upgrade of those models. The work included:

- Evaluation of current Illuminating Engineering Society (IES) guidelines for lighting of commercial interiors (recommended footcandles, or illuminance, at the work plane) for all spaces. The ANSI/IES Recommended Practice (RP28-2016 for Seniors and the Low Vision Population) was used to inform both illuminance levels and fixture selection for space types in Facilities for the Visually Impaired.
- Expansion of categories used to assign room surface reflectance for each space type, based on actual usage, not just design “rules of thumb.” Previously, most spaces were assumed to have ceiling surfaces of 70% reflectance, wall surfaces of 50% reflectance and floor surfaces of 20% reflectance (70/50/20). Through a consensus process, the developers of this proposal agreed to select the wall surface reflectance as the primary surface. Many spaces were reassigned to the category of 50/30/20 reflectance and some were reassigned to the 30/10/20 category.
- Update and expansion of the lighting fixture database. 100% of the fixtures are solid state (LED), using current off-the-shelf technology (fixture efficacy)
- Improvement of the high color quality data set for LED fixtures used in spaces that previously had incandescent, halogen or premium HID
- Standardization on a Light Loss Factor for LED of 0.85, not the End of Useful Life metric of 0.70
- Improvement of the wallwashing methodology for spaces where vertical surface illumination was deemed important

Additionally, the building data set, developed using Dodge Data & Analytics and the National Construction Database, was reviewed to assure that the actual buildings assigned to each Building type better reflected that Building type. It was agreed by the developers of this proposal that a filter should be applied (where possible) based on the criteria that at least 33% of the underlying space-by-space data must represent spaces that are the larger Building Area category. Previously, if the space-by-space mixture contained a large portion of spaces that differed from the larger Building Area category, it could result in a Building Area LPD value that was significantly different from the appropriate Space-by-Space LPDs. The values proposed here are a better composite of the spaces. The overall reduction across all building types will result in energy savings of approximately 5% over IECC 2018.

Bibliography: Addendum CG to ASHRAE Standard 90.1-2016

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. The Lighting Power Density values proposed in this code change proposal utilize off-the-shelf current LED technology and do not require additional or more expensive luminaires. The efficacy chosen for the models was based on the average of a fixture data set using luminaires from multiple manufacturers. Specifiers and users can find light fixtures that will allow the project to meet code at reasonable price points. Data gathered from industry partners indicates that product development is all directed at solid-state (LED) lighting with many traditional fixtures and lamp sources being discontinued.

CE207-19

IECC: TABLE C405.3.2(2)

Proponent: Glenn Heinmiller, Lam Partners, representing International Association of Lighting Designers (glenn@lampartners.com); Jack Bailey, representing International Association of Lighting Designers (jbailey@oneluxstudio.com)

2018 International Energy Conservation Code

Revise as follows:

TABLE C405.3.2(2)
INTERIOR LIGHTING POWER ALLOWANCES: SPACE-BY-SPACE METHOD

COMMON SPACE TYPES ^a	LPD (watts/sq.ft)
Atrium	
Less than 40 feet in height	0.03 per foot in total height <u>0.48</u>
Greater than 40 feet in height	0.40 + 0.02 per foot in total height <u>0.60</u>
Audience seating area	
In an auditorium	0.63 <u>0.61</u>
In a convention center	0.82
In a gymnasium	0.65 <u>0.23</u>
In a motion picture theater	1.14 <u>0.27</u>
In a penitentiary	0.28 <u>0.67</u>
In a performing arts theater	2.03 <u>1.16</u>
In a religious building	1.53 <u>0.72</u>
In a sports arena	0.43 <u>0.33</u>
Otherwise	0.43 <u>0.23</u>
Banking activity area	0.86 <u>0.61</u>
Breakroom (See Lounge/breakroom)	
Classroom/lecture hall/training room	
In a penitentiary	1.34 <u>0.89</u>
Otherwise	0.96 <u>0.71</u>
Computer room	1.33 <u>0.94</u>
Conference/meeting/multipurpose room	1.07 <u>0.97</u>
Copy/print room	0.56
Corridor	
In a facility for the visually impaired (and not used primarily by the staff) ^b	0.92 <u>0.71</u>
In a hospital	0.92 <u>0.71</u>
In a manufacturing facility	0.29
Otherwise	0.66 <u>0.41</u>
Courtroom	1.39 <u>1.20</u>

Dining area	
In bar/lounge or leisure dining	0.93 <u>0.86</u>
In cafeteria or fast food dining	0.63 <u>0.40</u>
In a facility for the visually impaired (and not used primarily by the staff) ^b	2.00 <u>1.27</u>
In family dining	0.71 <u>0.60</u>
In a penitentiary	0.96 <u>0.42</u>
Otherwise	0.63 <u>0.43</u>
Electrical/mechanical room	0.43
Emergency vehicle garage	0.41 <u>0.52</u>
Food preparation area	1.06 <u>1.09</u>
Guestroom ^{c, d}	0.77 <u>0.41</u>
Laboratory	
In or as a classroom	1.20 <u>1.11</u>
Otherwise	1.45 <u>1.33</u>
Laundry/washing area	0.43 <u>0.53</u>
Loading dock, interior	0.58 <u>0.88</u>
Lobby	
For an elevator	0.68
In a facility for the visually impaired (and not used primarily by the staff) ^b	2.03 <u>1.69</u>
In a hotel	1.06 <u>0.51</u>
In a motion picture theater	0.45 <u>0.23</u>
In a performing arts theater	1.70 <u>1.25</u>
Otherwise	1.0
Locker room	0.48 <u>0.52</u>
Lounge/breakroom	
In a healthcare facility	0.78 <u>0.42</u>
Otherwise	0.62 <u>0.59</u>
Office	
Enclosed	0.93 <u>0.74</u>
Open plan	0.81 <u>0.61</u>
Parking area, interior	0.14 <u>0.15</u>
Pharmacy area	1.34 <u>1.66</u>
Restroom	
In a facility for the visually impaired (and not used primarily by the staff) ^b	0.96 <u>1.26</u>
Otherwise	0.85 <u>0.63</u>
Sales area	1.22 <u>1.05</u>
Seating area, general	0.42 <u>0.23</u>
Stairway (see Space containing stairway)	

Stairwell	0.58 <u>0.49</u>
Storage room	0.46 <u>0.51</u>
Storage room - small materials	0.62
Vehicular maintenance area	0.56 <u>0.60</u>
Workshop	1.14 <u>1.26</u>
BUILDING TYPE SPECIFIC SPACE TYPES ^a	LPD (watts/sq.ft)
Automotive (see Vehicular maintenance area)	
Convention Center—exhibit space	0.88 <u>0.61</u>
Dormitory—living quarters ^{c, d}	0.54 <u>0.50</u>
Facility for the visually impaired ^b	
In a chapel (and not used primarily by the staff)	1.06 <u>0.70</u>
In a recreation room (and not used primarily by the staff)	1.80 <u>1.77</u>
Fire Station—sleeping quarters ^c	0.20 <u>0.23</u>
Gymnasium/fitness center	
In an exercise area	0.50 <u>0.90</u>
In a playing area	0.82 <u>0.85</u>
Healthcare facility	
In an exam/treatment room	1.68 <u>1.40</u>
In an imaging room	1.06 <u>0.94</u>
In a medical supply room	0.54 <u>0.62</u>
In a nursery	1.00 <u>0.92</u>
In a nurse's station	0.81 <u>1.17</u>
In an operating room	2.17 <u>2.26</u>
In a patient room ^c	0.62 <u>0.68</u>
In a physical therapy room	0.84 <u>0.91</u>
In a recovery room	1.03 <u>1.25</u>
Library	
In a reading area	0.82 <u>0.96</u>
In the stacks	1.20 <u>1.18</u>
Manufacturing facility	
In a detailed manufacturing area	0.93 <u>0.80</u>
In an equipment room	0.65 <u>0.76</u>
In an extra-high-bay area (greater than 50' floor-to-ceiling height)	1.05 <u>1.42</u>
In a high-bay area (25-50' floor-to-ceiling height)	0.75 <u>1.24</u>
In a low-bay area (less than 25' floor-to-ceiling height)	0.96 <u>0.86</u>
Museum	
In a general exhibition area	1.05 <u>0.31</u>
In a restoration room	0.85 <u>1.10</u>
Performing arts theater—dressing room	0.36 <u>0.41</u>
Post office—sorting area	0.68 <u>0.76</u>

Religious buildings	
In a fellowship hall	0.55 <u>0.54</u>
In a worship/pulpit/choir area	1.53 <u>0.85</u>
Retail facilities	
In a dressing/fitting room	0.50 <u>0.51</u>
In a mall concourse	0.90 <u>0.82</u>
Sports arena—playing area	
For a Class I facility ^e	2.47 <u>2.94</u>
For a Class II facility ^f	1.96 <u>2.01</u>
For a Class III facility ^g	1.70 <u>1.30</u>
For a Class IV facility ^h	1.13 <u>0.86</u>
Transportation facility	
In a baggage/carousel area	0.45 <u>0.39</u>
In an airport concourse	0.31 <u>0.25</u>
At a terminal ticket counter	0.62 <u>0.51</u>
Warehouse—storage area	
For medium to bulky, palletized items	0.35 <u>0.33</u>
For smaller, hand-carried items	0.69 <u>0.69</u>

- a. In cases where both a common space type and a building area specific space type are listed, the building area specific space type shall apply
- b. A 'Facility for the Visually Impaired' is a facility that is licensed or will be licensed by local or state authorities for senior long-term care, adult daycare, senior support or people with special visual needs.
- c. Where sleeping units are excluded from lighting power calculations by application of Section R405.1, neither the area of the sleeping units nor the wattage of lighting in the sleeping units is counted.
- d. Where dwelling units are excluded from lighting power calculations by application of Section R405.1, neither the area of the dwelling units nor the wattage of lighting in the dwelling units is counted.
- e. Class I facilities consist of professional facilities; and semiprofessional, collegiate, or club facilities with seating for 5,000 or more spectators.
- f. Class II facilities consist of collegiate and semiprofessional facilities with seating for fewer than 5,000 spectators; club facilities with seating for between 2,000 and 5,000 spectators; and amateur league and high-school facilities with seating for more than 2,000 spectators.
- g. Class III facilities consist of club, amateur league and high-school facilities with seating for 2,000 or fewer spectators.
- h. Class IV facilities consist of elementary school and recreational facilities; and amateur league and high-school facilities without provision for spectators.

Reason: This proposal revises the lighting power density allowances to the best available values. "Best" means values that will lead to high energy-efficiency while still allowing high-quality lighting and sufficient light levels. We believe that the best source for these values is the process of the ASHRAE/IES 90.1 Lighting Subcommittee supported by PNNL/DOE. The IALD participates in the development of these values through our representation on the 90.1 Lighting Subcommittee and through the ANSI/ASHRAE/IES public review commenting process.

During this code cycle a detailed review and upgrade of the Space-by-space LPD models was performed by the 90.1 Lighting Subcommittee, rather than a simple update as in past code cycles. Because of this, we have even more confidence in these numbers.

The basis of the values in our proposal is Addendum BB to ASHRAE/IES Standard 90.1 Second Public Review Draft (November 2018). Addendum BB to Standard 90.1 is still a work-in-progress at the time of the submission of this code change proposal for IECC. We know that some of the LPD values will be revised before the publication of 90.1-2019. These values in our proposal are based on our involvement in the ongoing public comment process for Addendum BB and our understanding of the work of the 90.1 Lighting Subcommittee since the Addendum BB Second Public Review Draft was published last November. This proposal contains values that will more closely match the final values that we expect will be 90.1-2019, and are appropriate for inclusion in IECC-2021.

Cost Impact: The code change proposal will not increase or decrease the cost of construction. Complying with these new lighting power allowances will require more careful design but will not require the use of more expensive lighting fixtures than would be used otherwise.

Proposal # 4595

CE207-19

CE208-19

IECC: TABLE C405.3.2(2)

Proponent: Connor Barbaree, representing ASHRAE (cbarbaree@ashrae.org)

2018 International Energy Conservation Code

Revise as follows:

TABLE C405.3.2(2)
INTERIOR LIGHTING POWER ALLOWANCES: SPACE-BY-SPACE METHOD

COMMON SPACE TYPES^a	LPD (watts/sq.ft ft²)
Atrium	
Less than 40 feet in height	0.03 per foot in total height <u>0.48</u>
Greater than 40 feet in height	0.40 + 0.02 per foot in total height <u>0.60</u>
Audience seating area	
In an auditorium	0.63 <u>0.61</u>
In a convention center	0.82
In a gymnasium	0.65 <u>0.23</u>
In a motion picture theater	1.14 <u>0.27</u>
In a penitentiary	0.28 <u>0.67</u>
In a performing arts theater	2.03 <u>1.16</u>
In a religious building	1.53 <u>0.72</u>
In a sports arena	0.43 <u>0.33</u>
Otherwise	0.43 <u>0.23</u>
Banking activity area	0.86 <u>0.61</u>
Breakroom (See Lounge/breakroom)	
Classroom/lecture hall/training room	
In a penitentiary	1.34 <u>0.89</u>
Otherwise	0.96 <u>0.71</u>
Computer room	1.33 <u>0.94</u>
Conference/meeting/multipurpose room	1.07 <u>0.97</u>
Copy/print room	0.56 <u>0.31</u>
Corridor	
In a facility for the visually impaired (and not used primarily by the staff) ^b	0.92 <u>0.71</u>
In a hospital	0.92 <u>0.71</u>
In a manufacturing facility	0.29
Otherwise	0.66 <u>0.41</u>
Courtroom	1.39 <u>1.20</u>
Dining area	

In bar/lounge or leisure dining	0.93 <u>0.86</u>
In cafeteria or fast food dining	0.63 <u>0.40</u>
In a facility for the visually impaired (and not used primarily by the staff) ^b	2.00 <u>1.27</u>
In family dining	0.71 <u>0.60</u>
In a penitentiary	0.96 <u>0.42</u>
Otherwise	0.63 <u>0.43</u>
Electrical/mechanical room	0.43
Emergency vehicle garage	0.41 <u>0.52</u>
Food preparation area	1.06 <u>1.09</u>
Guestroom ^{c, d}	0.77 <u>0.41</u>
Laboratory	
In or as a classroom	1.20 <u>1.11</u>
Otherwise	1.45 <u>1.33</u>
Laundry/washing area	0.43 <u>0.53</u>
Loading dock, interior	0.58 <u>0.88</u>
Lobby	
For an elevator	0.68 <u>0.65</u>
In a facility for the visually impaired (and not used primarily by the staff) ^b	2.03 <u>1.69</u>
In a hotel	1.06 <u>0.51</u>
In a motion picture theater	0.45 <u>0.23</u>
In a performing arts theater	1.70 <u>1.25</u>
Otherwise	1.0 <u>0.84</u>
Locker room	0.48 <u>0.52</u>
Lounge/breakroom	
In a healthcare facility	0.78 <u>0.42</u>
Otherwise	0.62 <u>0.59</u>
Office	
Enclosed	0.93 <u>0.74</u>
Open plan	0.81 <u>0.61</u>
Parking area, interior	0.14 <u>0.15</u>
Pharmacy area	1.34 <u>1.66</u>
Restroom	
In a facility for the visually impaired (and not used primarily by the staff) ^b	0.96 <u>1.26</u>
Otherwise	0.85 <u>0.63</u>
Sales area	1.22 <u>1.05</u>
Seating area, general	0.42 <u>0.23</u>
Stairway (see Space containing stairway)	
Stairwell	0.58 <u>0.49</u>

Storage room	0.46 <u>0.38</u>
Vehicular maintenance area	0.56 <u>0.60</u>
Workshop	1.14 <u>1.26</u>
BUILDING TYPE SPECIFIC SPACE TYPES ^a	LPD (watts/sq-ft ft ²)
Automotive (see Vehicular maintenance area)	
Convention Center—exhibit space	0.88 <u>0.61</u>
Dormitory—living quarters ^{c, d}	0.54 <u>0.50</u>
Facility for the visually impaired ^b	
In a chapel (and not used primarily by the staff)	1.06 <u>0.70</u>
In a recreation room (and not used primarily by the staff)	1.80 <u>1.77</u>
Fire Station—sleeping quarters ^c	0.20 <u>0.23</u>
Gymnasium/fitness center	
In an exercise area	0.50 <u>0.90</u>
In a playing area	0.82 <u>0.85</u>
Healthcare facility	
In an exam/treatment room	1.68 <u>1.40</u>
In an imaging room	1.06 <u>0.94</u>
In a medical supply room	0.54 <u>0.62</u>
In a nursery	1.00 <u>0.92</u>
In a nurse's station	0.81 <u>1.17</u>
In an operating room	2.17 <u>2.26</u>
In a patient room ^c	0.62 <u>0.68</u>
In a physical therapy room	0.84 <u>0.91</u>
In a recovery room	1.03 <u>1.25</u>
Library	
In a reading area	0.82 <u>0.96</u>
In the stacks	1.20 <u>1.18</u>
Manufacturing facility	
In a detailed manufacturing area	0.93 <u>0.80</u>
In an equipment room	0.65 <u>0.76</u>
In an extra-high-bay area (greater than 50' floor-to-ceiling height)	1.05 <u>1.42</u>
In a high-bay area (25-50' floor-to-ceiling height)	0.75 <u>1.24</u>
In a low-bay area (less than 25' floor-to-ceiling height)	0.96 <u>0.86</u>
Museum	
In a general exhibition area	1.05 <u>0.31</u>
In a restoration room	0.85 <u>1.10</u>
Performing arts theater—dressing room	0.36 <u>0.41</u>
Post office—sorting area	0.68 <u>0.76</u>
Religious buildings	
In a fellowship hall	0.55 <u>0.54</u>

In a worship/pulpit/choir area	1.53 <u>0.85</u>
Retail facilities	
In a dressing/fitting room	0.50 <u>0.51</u>
In a mall concourse	0.90 <u>0.82</u>
Sports arena—playing area	
For a Class I facility ^e	2.47 <u>2.94</u>
For a Class II facility ^f	1.96 <u>2.01</u>
For a Class III facility ^g	1.70 <u>1.30</u>
For a Class IV facility ^h	1.13 <u>0.86</u>
Transportation facility	
In a baggage/carousel area	0.45 <u>0.39</u>
In an airport concourse	0.31 <u>0.25</u>
At a terminal ticket counter	0.62 <u>0.51</u>
Warehouse—storage area	
For medium to bulky, palletized items	0.35 <u>0.33</u>
For smaller, hand-carried items	0.69

- a. In cases where both a common space type and a building area specific space type are listed, the building area specific space type shall apply
- b. A 'Facility for the Visually Impaired' is a facility that is licensed or will be licensed by local or state authorities for senior long-term care, adult daycare, senior support or people with special visual needs.
- c. Where sleeping units are excluded from lighting power calculations by application of Section R405.1, neither the area of the sleeping units nor the wattage of lighting in the sleeping units is counted.
- d. Where dwelling units are excluded from lighting power calculations by application of Section R405.1, neither the area of the dwelling units nor the wattage of lighting in the dwelling units is counted.
- e. Class I facilities consist of professional facilities; and semiprofessional, collegiate, or club facilities with seating for 5,000 or more spectators.
- f. Class II facilities consist of collegiate and semiprofessional facilities with seating for fewer than 5,000 spectators; club facilities with seating for between 2,000 and 5,000 spectators; and amateur league and high-school facilities with seating for more than 2,000 spectators.
- g. Class III facilities consist of club, amateur league and high-school facilities with seating for 2,000 or fewer spectators.
- h. Class IV facilities consist of elementary school and recreational facilities; and amateur league and high-school facilities without provision for spectators.

Reason: Based on data gathered from industry partners and design professionals, practical LPD values have been determined. These LPD values are not just an update to existing models, but instead, include an extensive review and upgrade of those models. The work included:

- Evaluation of current Illuminating Engineering Society (IES) guidelines for lighting of commercial interiors (recommended footcandles, or illuminance, at the work plane) for all spaces. The ANSI/IES Recommended Practice (RP28-2016 for Seniors and the Low Vision Population) was used to inform both illuminance levels and fixture selection for space types in Facilities for the Visually Impaired.

- Expansion of categories used to assign room surface reflectance for each space type, based on actual usage,

not just design “rules of thumb.” Previously, most spaces were assumed to have ceiling surfaces of 70% reflectance, wall surfaces of 50% reflectance and floor surfaces of 20% reflectance (70/50/20). Through a consensus process, the developers of this proposal agreed to select the wall surface reflectance as the primary surface. Many spaces were reassigned to the category of 50/30/20 reflectance and some were reassigned to the 30/10/20 category.

- Update and expansion of the lighting fixture database. 100% of the fixtures are solid state (LED), using current off-the-shelf technology (fixture efficacy)

- o Improvement of the high color quality data set for LED fixtures used in spaces that previously had incandescent, halogen or premium HID

- Standardization on a Light Loss Factor for LED of 0.85, not the End of Useful Life metric of 0.70

- Improvement of the wallwashing methodology for spaces where vertical surface illumination was deemed important

This methodology resulted in reductions in many LPDs, and increases in some. The overall reduction across all space types will result in energy savings of approximately 5% over IECC 2018.

Two space types were eliminated based on input from industry professionals: Audience Seating in a Convention Center and Corridor in a Manufacturing Facility. They were eliminated for similar reasons; the lighting specifier has to design for the entire space in a Convention Center or Manufacturing Facility. The seating area in a convention center is completely flexible based on user preference for each event. Similarly, corridors in Manufacturing Facilities are most often the circulation created between pieces of equipment or workbenches. Specifiers and users have allowances to use for Convention Centers and Manufacturing Facilities.

Bibliography: Addendum BB to ANSI/ASHRAE/IES Standard 90.1-2016, Energy Standard for Buildings Except Low-Rise Residential Buildings

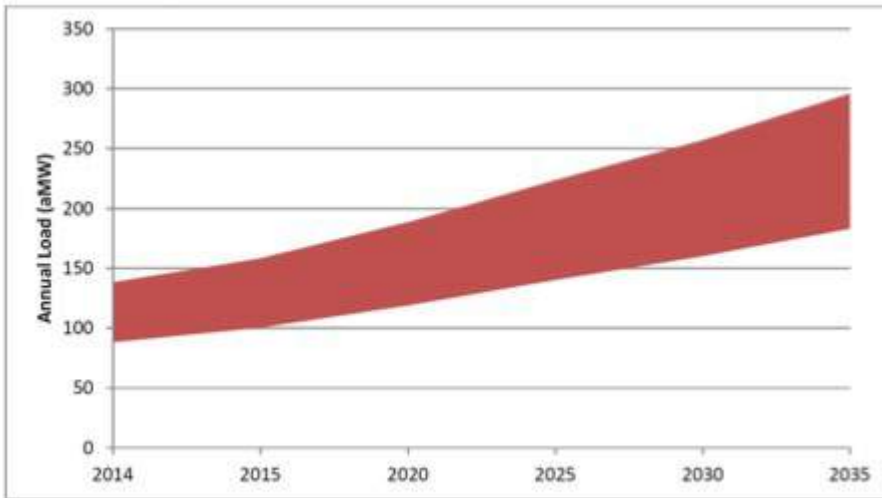
Cost Impact: The code change proposal will not increase or decrease the cost of construction. The Lighting Power Density values proposed in this code change proposal utilize off-the-shelf current LED technology and do not require additional or more expensive luminaires. The efficacy chosen for the models was based on the average of a fixture data set using luminaires from multiple manufacturers. Specifiers and users can find light fixtures that will allow the project to meet code at reasonable price points. Data gathered from industry partners indicates that product development is all directed at solid-state (LED) lighting with many traditional fixtures and lamp sources being discontinued.

Proposal # 5522

CE208-19








demand. Indoor agriculture operations not related to marijuana are expanding too. Indoor horticulture facilities can have EUIs that exceed even data centers.

PACIFIC NORTHWEST CANNABIS ENERGY LOAD FORECAST



Source: Northwest Power & Planning Council, Seventh Power Plan, March 2016

ENERGY INTENSITY COMPARISONS

	Typical Site EUI* kBtu/sf	kWh/sf (of flowering canopy)	grams/kWh (of final product in flower form)
 Outdoor (Sungrown)**	n/a	0	16
 Greenhouse (Light Deprivation)**	84	33	8
 Indoor (Efficient)**	~600	234	1+
 Indoor (Inefficient)**	~1300	500+	1-
 Office Building***	67	n/a	n/a
 Hospital***	197	n/a	n/a
 Data Center***	~600	n/a	n/a

*Assumes 75% of grow facility floor space is used for flowering canopy

**Data source: Self-Reported producer data from the Resource Innovation Institute Cannabis PowerScore

***Data source: US Energy Star Portfolio Manager

The price of LEDs has fallen dramatically in the past few years and local food movements in cities are driving increased demand for fresh high-quality produce that is grown close to the point of consumption. More restaurants are interested in sourcing ingredients directly from the producer, and in dense urban areas a growing number of new indoor agriculture operations have begun to meet this demand. This potent combination of policy, technology, and market factors is driving a dramatic expansion in indoor agriculture. As written, the 2018 IECC leaves lighting in this growing energy load completely exempt from efficiency requirements.

This proposal removes the loophole by requiring lighting used for plant growth or maintenance to either meet an efficiency metric. The efficiency metric of 1.6 $\mu\text{mol}/\text{J}$ (micromoles per Joule) was developed in collaboration with the American Society of Agricultural and Biological Engineers and was developed specifically for lighting used for plant growth. It measures the number of photons emitted from the fixture per Joule of energy consumed. Lighting Power Density was developed as a metric to evaluate the light usable for visual tasks relative to the power consumed. Likewise, this metric was developed specifically to measure the light usable for

plant growth relative to the power consumed. This metric is codified as an ANSI standard (ANSI/ASABE S640 – Quantities and Units of Electromagnetic Radiation for Plants (Photosynthetic Organisms)) and is already seeing wide adoption in the industry with over 84 products available that meet this requirement when surveyed in 2016. More information on the metric can be found in the ANSI Standard: ANSI/ASABE S640.

Using a typical High Pressure Sodium lamps (a common growing light) as the baseline, this requirement will result in 78% savings. That is a substantially lower lighting load and a reduction in the cooling load.

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

The proposal could marginally add to the cost of construction. The cost of horticultural lighting fixtures is actually driven to a large extent by reflectors and ventilation needs (horticultural lighting is positioned very close to the plants and venting the heat is essential) and not just lighting technology. Therefore, fixture cost can vary dramatically, from \$25/fixture to almost \$1000/fixture for High Pressure Sodium fixtures and from \$75/fixture to well over \$1000/fixture for LED. And advancements and expanding market share of LED lighting has narrowed the impact of lighting technology. Therefore, lighting that meets this requirement can be obtained for less than lighting that does not. The only projects that will see an increase in cost are those using the absolute cheapest lighting that does not meet the requirement.

Proposal # 5155

CE209-19

CE210-19

IECC: C405.4.1, C405.4.2

Proponent: Jonathan McHugh, representing McHugh Energy Consultants Inc. (jon@mchughenergy.com)

2018 International Energy Conservation Code

Revise as follows:

C405.4.1 Total connected exterior building exterior lighting power. The total exterior connected lighting power shall be the total maximum rated wattage of all lighting ~~that is powered through the energy service for the building- applications listed in Table C405.4.2(2) and Table C405.4.2(3).~~

Exception: Lighting used for the following applications shall not be included.

1. Lighting *approved* because of safety considerations.
2. Emergency lighting automatically off during normal business operation.
3. Exit signs.
4. Specialized signal, directional and marker lighting associated with transportation.
5. Advertising signage or directional signage.
6. Integral to equipment or instrumentation and installed by its manufacturer.
7. Theatrical purposes, including performance, stage, film production and video production.
8. Athletic playing areas.
9. Temporary lighting.
10. Industrial production, material handling, transportation sites and associated storage areas.
11. Theme elements in theme/amusement parks.
12. Used to highlight features of art, public monuments, and the national flag.
13. Lighting for water features and swimming pools.
14. Lighting controlled from within dwelling units, where the lighting complies with Section R404.1.

C405.4.2 Exterior lighting power allowance. The total exterior lighting power allowance is the sum of the base site allowance plus the individual allowances for areas that are to be illuminated by lighting ~~that is powered through the energy service for the building.~~ Lighting power allowances are as specified in Table C405.4.2(2). The lighting zone for the building exterior is determined in accordance with Table C405.4.2(1) unless otherwise specified by the *code official*.

Reason: This proposal would increase the scope of outdoor lighting requirements to all commercial lighting applications in Table C405.4.2(2) and Table 405.4.2(3) regardless of whether the power to these outdoor lighting applications passes through a building's service. Examples of outdoor lighting energy efficiency that is "falling between the cracks" of effective regulation include:

- parking lot lighting for malls where the service entrance is not associated with any building on the site.
- parking lot lighting not associated with any building, such as might be adjacent to ball fields, fairgrounds etc.

Cost Impact: The code change proposal will not increase or decrease the cost of construction. This proposal will increase the scope of the current IECC lighting requirements to more applications but the stringency and cost are not being increased.

Proposal # 5610

CE210-19

CE211-19

IECC: C405.4.2, C405.4.2.1

Proponent: Glenn Heinmiller, Lam Partners, representing International Association of Lighting Designers (glenn@lampartners.com); Jack Bailey (jbailey@oneluxstudio.com)

2018 International Energy Conservation Code

Delete and substitute as follows:

~~**C405.4.2 Exterior lighting power allowance.** The total exterior lighting power allowance is the sum of the base site allowance plus the individual allowances for areas that are to be illuminated by lighting that is powered through the energy service for the building. Lighting power allowances are as specified in Table C405.4.2(2). The lighting zone for the building exterior is determined in accordance with Table C405.4.2(1) unless otherwise specified by the code official.~~

C405.4.2 Exterior lighting power allowance. The exterior lighting power allowance (watts) is calculated as follows:

1. Determine the Lighting Zone (LZ) for the building according to Table C405.4.2(1) unless otherwise specified by the code official.
2. For each exterior area that is to be illuminated by lighting that is powered through the energy service for the building, determine the applicable area type from Table C405.4.2(2). For area types not listed, select the area type that most closely represents the proposed use of the area.
3. Determine the total area or length of each area type and multiply by the value for the area type in Table C405.4(2) to determine the lighting power (Watts) allowed for each area type.
4. The total exterior lighting power allowance (Watts) is the sum of the base site allowance determined according to Table C405.4.2(2), plus the Watts from each area type.

Revise as follows:

C405.4.2.1 Additional exterior lighting power. ~~Any increase in the Additional exterior lighting power allowance is limited to allowances are available for the specific lighting applications indicated listed in Table C405.4.2(3). The These additional power allowances shall be used only for the luminaires that are serving these specific applications and shall not be used for to increase any other purpose: lighting power allowance.~~

Reason: This proposal clarifies the calculation procedures for compliance with exterior lighting power requirements. Currently the code does not provide clear or complete direction. There is no change in stringency. This proposal makes this calculation procedure easier to understand and will increase the usability of the code. Codes which are usable are more likely to be complied with and are easier to enforce.

Cost Impact: The code change proposal will not increase or decrease the cost of construction
This proposal is a re-write to clarify code requirements.

Proposal # 4617

CE211-19

CE212-19

IECC: C405.8.1, C405.8.2, C405.8.2.1, C405.9, C407.2

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:

C405.8.1 Elevator cabs (Mandatory). For the luminaires in each elevator cab, not including signals and displays, the sum of the lumens divided by the sum of the watts shall be not less than 35 lumens per watt. Ventilation fans in elevators that do not have their own air-conditioning system shall not consume more than 0.33 watts/cfm at the maximum rated speed of the fan. Controls shall be provided that will de-energize ventilation fans and lighting systems when the elevator is stopped, unoccupied and with its doors closed for over 15 minutes.

C405.8.2 Escalators and moving walks (Mandatory). Escalators and moving walks shall comply with ASME A17.1/CSA B44 and shall have automatic controls configured to reduce speed to the minimum permitted speed in accordance with ASME A17.1/CSA B44 or applicable local code when not conveying passengers.

Exception: A variable voltage drive system that reduces operating voltage in response to light loading conditions is an alternative to the reduced speed function.

C405.8.2.1 Regenerative drive (Mandatory). An escalator designed either for one-way down operation only or for reversible operation shall have a variable frequency regenerative drive that supplies electrical energy to the building electrical system when the escalator is loaded with passengers whose combined weight exceeds 750 pounds (340 kg).

C405.9 Voltage drop in feeders and branch circuits (Mandatory). The total *voltage drop* across the combination of feeders and branch circuits shall not exceed 5 percent.

C407.2 Mandatory requirements. Compliance with this section requires compliance with Sections C402.5, C403.2, C403.3 through C403.3.2, C403.4 through C403.4.2.3, C403.5.5, C403.7, C403.8.1 through C403.8.4, C403.10.1 through C403.10.3, C403.11, C403.12, C404 and ~~C405~~ C405.1, C405.2, C405.4 through C405.9.

Reason: The provisions of C405.8.1, C405.8.2, and C405.9 are a combination of performance requirements and references to standards, with no associated performance metrics or values available to model or trade in the performance path.

For this reason C405.8.1, C405.8.2, and C405.9 are mandatory. This is consistent with the parallel provisions of ASHRAE 90.1 10.4.3, 10.4.4, and 8.4.1, which are identified 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>

(<http://www.iccsafe.org/cs/SEHPCAC/Pages/default.aspx>)

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

As commonly interpreted, these items are already considered mandatory, and therefor should have no impact on cost. However, it may increase the cost of construction for a subset of buildings designed to comply with Section C407 that do not include the specifications for vertical and horizontal transportation systems as included in Section C405.8 and C405.9.

Proposal # 4190

CE212-19

CE213-19

IECC: C405.8.2, C405.8.2.1

Proponent: Kevin Brinkman, representing National Elevator Industry, Inc. (klbrinkman@neii.org)

2018 International Energy Conservation Code

Revise as follows:

C405.8.2 Escalators and moving walks. Escalators and moving walks shall comply with ASME A17.1/CSA B44 and Where a traffic analysis indicates that an escalator or moving walk application will have sufficient periods with no riders while it is operating, it shall have automatic controls configured to that reduce speed to the minimum as permitted speed in accordance with ASME A17.1/CSA B44 or applicable local code when not conveying passengers.

Exception: A variable voltage drive system that reduces operating voltage in response to light loading conditions is an alternative to the reduced speed function.

~~C405.8.2.1 Regenerative drive. Power Recovery.~~ ~~An escalator designed either for one-way down operation only or for reversible operation shall have a variable frequency regenerative drive that supplies electrical energy to the building electrical system when the escalator is loaded.~~ Where a traffic analysis indicates that an escalator application will have sufficient periods in the down direction with passengers whose combined weight exceeds 750 pounds (340 kg), the escalator shall be designed to recover, on average, more power than is consumed by the power recovery feature of its motor controller system.

Reason: The universal application of technology designed for energy efficiency improvement imposed by the current requirement may actually increase energy consumption in many applications. The proposed revision would require a traffic analysis to determine whether the technology would actually be beneficial or detrimental. The proposal also used more prescriptive language for the power recovery to allow designers and manufacturers to select the most energy efficient technology for the application.

C405.8.2: Depending on the escalator or moving walk application, varying speeds may actually increase energy usage. Each time the escalator or moving walk returns to the normal operating speed from its reduced speed condition, more energy is consumed to create the acceleration needed. In applications where the amount of time that there are no riders is very short, the energy consumed during the acceleration stage may actually exceed what is saved during the reduced speed segments. The traffic analysis can be used to calculate the anticipated savings, if any, to determine whether the technology should be applied and the return on investment.

C405.8.2.1: It should be noted that most, if not all, escalators are designed to be reversible, so the provision in the current edition would be applied to all escalators, including those that always run in the up direction. Depending on the escalator application, there may be only marginal gains in applying one technical solution over another and therefore no single technical solution should be prescribed for all escalators as stated in the current standard. The proposed language uses more prescriptive language for the power recovery to allow designers and manufacturers to select the most energy efficient technology for the application and ensure that if applied it actually recovers more power on average than the added feature would consume. [Note: some examples may include direct induction motor regeneration, variable frequency regeneration motor controller, or various combinations of the two.]

To further illustrate the deficiencies in the current language and support the need for an analysis to determine the best option for energy usage, three hypothetical scenarios are provided below with three configurations of motor controller-motor energy recovery arrangements. In each configuration, power recovery (regen power) back to the supply system can only be realized when the escalator is running in the down direction with a

sufficient load to overcome friction. (See sample motor controller configuration diagrams under Technical Backup).

Electrical DATA

Rise: 18' (approx. 6m)

Power: 15Hp/11kW

Power factor (Pf) 0.75

Voltage: 480VAC

Configuration 1 is an electro-mechanical motor controller with an AC induction motor that can feed direct power back to the power supply system when the escalator is running in the down direction with sufficient load.

Configuration 2 is an electronic motor controller with no regeneration capability but can reduce escalator speed when there are no riders on it, and uses the AC motor to feed direct power back to the power supply system when the escalator is running in the down direction with sufficient load.

Configuration 3 is an electronic motor controller with regeneration capability back to the power supply system when the escalator is running in the down direction with sufficient load driving an AC induction motor.

A) Approximate additional energy consumption (kW/hr.) by the controller for the four types of motor controls considered (electro-mechanical is baseline):

1. Electro-mechanical motor controller with AC induction motor ~ 0 kW
2. Electronic motor controller (VVVF) without regen and with AC induction motor ~ 0.285 kW
3. Electronic motor controller (VVVF Pf1 regen type) with AC induction motor ~ 0.430 kW

B) Approximate energy saved (kW/hr.) at reduced speed for the three types of motor controls considered:

1. Electro-mechanical motor controller with AC induction motor ~ 0 kW (reduced speed not possible)
2. Electronic motor controller (VVVF) without regen and with AC induction motor ~ 1.5 kW
3. Electronic motor controller (VVVF Pf1 regen type) with AC induction motor ~ 1,5 kW

C) Approximate energy recovered (kW/hr) by the escalator for the three types of motor controls considered:

1. Electro-mechanical motor controller with AC induction motor ~ 3 kW
2. Electronic motor controller (VVVF) without regen and with AC induction motor ~ 3 kW
3. Electronic motor controller (VVVF Pf1 regen type) with AC induction motor ~ 4 kW

Summary: From the three application scenarios below, it will be seen that the energy savings from each configuration very much depends upon the application and use of the escalator:

- The single dedicated down airport escalator in Scenario 1 with the VVVF Pf1 regenerative motor controller of Configuration 3 provides the best energy efficiency. This configuration is specified by the current standard.
- The single up escalator with a peak hour down direction in scenario 2 is better suited with the VVVF motor controller in Configuration 2 that can reduce the speed of the escalator when no riders are present but uses the AC motor to feed direct power back to the power supply system when the escalator is moving in the down direction with sufficient load.
- The heavily used bi-directional shopping mall escalators in Scenario 3 will consume more energy with the added speed reduction and power recovery features of Configuration 2 and 3 than they would by simply allowing the AC induction motor of Configuration 1 to recover direct energy from the induction motor whenever possible.

The NEII proposed code modifications address the application sensitivity in achieving energy recovery and savings by making the application of the conveyance a factor in selecting the best suited energy saving configuration.

Application Scenario 1

An airport is open 18 hours per day with a dedicated down escalator to baggage claim. When flights arrive, it is loaded with more than 75% capacity for 5 minutes for each flight and zero load the remainder of the time. One hundred and twenty arriving flights per day use this baggage claim escalator.

Escalators load during the 18 operating hours:

1. 0% load for 8 hours (=Total time where reduced speed can be applied)
2. > 0%, < 75% load for 0 hours
3. 75% load or more for 10 hours

Motor Controller (Operating 18 hours/day)	A) Controller power ~kW consumption		B) Reduced speed ~kW saved		C) Regen ~kW recovered		Energy saved Power ~kW
	Up	Down	Up	Down	Up	Down	Total
1. Electro-mechanical with AC induction motor that provides regen	0	0	0	0	0	30	30
2. Electronic controller with AC induction motor that provides power recuperation capability	0	5.1	0	12	0	30	38.90
3. Electronic controller (Pf1 regen type) with AC induction motor	0	7.74	0	12	0	40	44.26

Application Scenario 2

A subway station open 22 hour per day has one escalator for each platform. Typically, the escalator runs in the up direction most of the time and in the down direction during peak rush hour. Scenario for reduced power consumption and regen power is as follows:

Escalators load during the 22 operating hours (20hrs up and 2hrs down):

1. 0% load for 10 hours up direction (Total time where reduced speed can be applied)
2. > 0%, < 75% load for 10 hours up direction
3. 75% load or more for 2 hours down direction

Motor Controller (Operating 22 hours/day)	A) Controller power ~kW consumption		B) Reduced speed ~kW saved		C) Regen ~kW recovered		Energy saved Power ~kW
	Up	Down	Up	Down	Up	Down	Total
1. Electro-mechanical with AC induction motor that provides regen	0	0	0	0	0	6	6
2. Electronic controller with AC induction motor that provides power recuperation capability	5.7	0.57	15	0	0	6	14.73
3. Electronic controller (Pf1 regen type) with AC induction motor	8.6	0.86	15	0	0	8	13.5

Application Scenario 3

A busy outdoor mall is open 12 hours per day has two escalators. Typically, one of the escalators will be running up and the other in the down direction. Both escalators can run down and each may be used for that direction from time to time. Scenario for reduced power consumption and regen power is as follows:

Escalators load during the 12 operating hours:

1. 0% load for 0 hours (Total time where reduced speed can be applied)
2. > 0%, < 75% load for 12 hours
3. 75% load or more for 0 hours

Motor Controller (Operating 12 hours/day)	A) Controller power (~kW) consumption		2) Reduced speed (0hrs) ~kW saved		3) Regen (0hr) ~kW recovered		Energy saved Power ~kW
	Up	Down	Up	Down	Up	Down	Total
1. Electro-mechanical with AC induction motor	0	0	0	0	0	0	0

2. Electronic controller with AC induction motor that provides power recuperation capability	3.4	3.4	0	0	0	0	(6.8)
3. Electronic controller (Pf1 regen type) with AC induction motor	5.16	5.16	0	0	0	0	(10.32)

Technical backup.

Energy is utilized by escalators for the following:

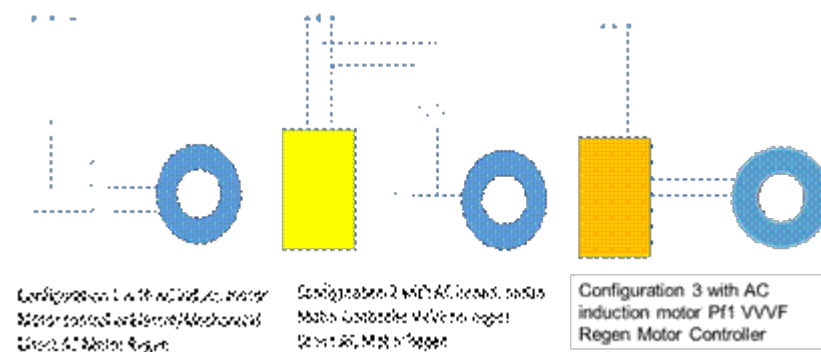
1. to overcome friction,
2. transport the load, and
3. inertia (starting) (insignificant for configuration 1 minimum for the others)

Because of the angle of inclination, transport of the escalator load is the dominate energy consumption area of the system to move a load up the inclination. However, the converse is true that when the load is being transported in the down direction, energy can be produced by the overhauling of the drive motor from the downward moving load and returned to the power system.

In general, an AC induction motor used to drive an escalator will produce power when it is in overhauling in the down direction with sufficient passenger loading to overcome the friction in the system. AC induction motors may be applied with simple electro-mechanical or fully electronic motor controllers and still provide this capability. Other variations of motor types, such as permanent magnet motors and variable voltage variable frequency motor control are also possible, and may also provide an energy saving reduced speed feature in the application. However, the electronics required for the various technologies to provide these motor control functions also consumes energy and must be weighed against the possible energy saving under the application and use of the escalator.

It should also be pointed out that in certain applications, escalators and moving walks with a speed reduction feature are confronted with flows of traffic that can cause the escalator or moving walk to continually switch between full to reduced speed and back to full speed. With a high enough frequency, this switching between slow to full speed will consume more energy than saved by the feature because of the need to accelerate the mass to full speed each time.

Example configurations (basic diagrams)



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

The code change proposal will decrease the cost of construction because it would allow alternate designs to achieve energy conservation.

CE214-19

IECC: C405.9

Proponent: Marilyn Williams, representing National Electrical Manufacturers Association
(mar_williams@nema.org)

2018 International Energy Conservation Code

Revise as follows:

C405.9 Voltage drop in feeders and branch circuits. The total *voltage drop* across the combination of ~~feeders customer-owned service conductors, feeder conductors~~ and branch circuits ~~conductors~~ shall not exceed 5 percent.

Reason: Revising this language will:

1. Increase energy efficiency
2. Reduce inconsistency and application confusion in compliance

The current requirement for voltage drop in feeder conductors does not include customer-owned service conductors. These are runs, owned by customers, from the utility service to the building main disconnect. These runs can be quite long which result in significant voltage drop and efficiency losses.

An editorial change adding the word "conductors" to feeder and branch circuits, provides greater clarity.

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

The increased cost in construction would only apply when the service feeder conductors are customer-owned and only if they would not have been designed to the 5% voltage drop allowance of the present code. This should represent a small subset of building construction projects. Additionally, the cost effectiveness of this code change remains the same as for all other service conductors under the present provision. This is not adding to stringency of this requirement. It only expands the conditions where the requirement is applied and maintains the cost effectiveness, as has been the case for the current voltage drop requirement.

Proposal # 4445

CE214-19

CE215-19

IECC: C405.10 (New), C405.10.1 (New), C405.10.2 (New),
TABLE C405.10.2 (New), C405.10.2 (New), C405.10.4 (New), C405.10.5(New)

Proponent: Marilyn Williams, representing National Electrical Manufacturers Association
(mar_williams@nema.org)

2018 International Energy Conservation Code

Add new text as follows:

C405.10 Energy Monitoring (Mandatory) New buildings with a gross conditioned floor area of 25,000 square feet or larger shall be equipped to measure, monitor, record and report energy consumption data in compliance with Section C406.10.1 through C406.10.5.

Exception: Individual tenant spaces are not required to comply with this section provided the space has its own utility services and meters and has less than 5,000 square feet of conditioned floor area.

C405.10.1 Electrical energy metering. For electrical energy, including all electrical energy supplied to the building and its associated site, including but limited to site lighting, parking, recreational facilities, and other areas that serve the building and its occupants, meters or other measurement devices shall be provided to collect energy consumption data for each end-use category required by Section C405.10.2.

C405.10.2 End-use metering categories. Meters or other approved measurement devices shall be provided to collect energy use data for each end-use category indicated in Table 405.10.2. Where multiple meters are used to measure any end-use category, the data acquisition system shall total all of the energy used by that category. Not more than 5 percent of the measured load for each of the end-use categories indicated in Table 405.10.2 shall be permitted to be from a load that is not within that category.

Exceptions:

1. HVAC and water heating equipment serving only an individual dwelling unit shall not require end-use metering.
2. End-use metering shall not be required for fire pumps, stairwell pressurization fans or any system that operates only during testing or emergency.
3. End-use metering shall not be required for an individual tenant space having a floor area not greater than 2,500 square feet where a dedicated source meter complying with Section C405.10.3 is provided.

TABLE C405.10.2
ENERGY USE CATEGORIES

<u>LOAD CATEGORY</u>	<u>DESCRIPTION OF ENERGY USE</u>
<u>Total HVAC System</u>	<u>Heating, cooling and ventilation including, but not limited to fans, pumps, boilers, chillers, and water heating. Energy used by 120 volt equipment, or by 208/120 volt equipment that is located in a building where the main service is 480/277 volt power, is permitted to be excluded from Total HVAC system energy use.</u>
<u>Interior Lighting</u>	<u>Lighting systems located within the building.</u>

<u>Exterior Lighting</u>	<u>Lighting systems located on the building site but not within the building.</u>
<u>Plug Loads</u>	<u>Devices, appliances and equipment connected to convenience receptacle outlets.</u>
<u>Process Loads</u>	<u>Any single load that is not included in a HVAC, lighting or plug load category and that exceeds 5 percent of the peak connected load of the whole building including, but not limited to data centers, manufacturing equipment and commercial kitchens.</u>
<u>Building Operations and other miscellaneous loads</u>	<u>The remaining loads not included elsewhere in this table including, but not limited to, vertical transportation systems, automatic doors, motorized shading systems, ornamental fountains, ornamental fireplaces, swimming pools, in-ground spas, and snow-melt systems.</u>

C405.10.3 Meters. Meters or other measurement devices required by this section shall be configured to automatically communicate energy consumption data to the data acquisition system required by Section C405.10.4. Source meters shall be allowed to be any digital-type meter. Lighting, HVAC, or other building systems that can monitor their energy consumption shall be permitted instead of meters. Current sensors shall be permitted, provided that they have a tested accuracy of plus or minus 2 percent. Required metering systems and equipment shall have the capability to provide at least hourly data that is fully integrated into the data acquisition system and graphical energy report in accordance with Sections C405.10.4 and C405.10.5.

C405.10.4 Data acquisition system A data acquisition system shall have the capability to store the data from the required meters and other sensing devices for minimum of 36 months. The data acquisition system shall have the capability to store real-time energy consumption data and provide hourly, daily, monthly, and yearly logged data for each end-use category required by Section C405.10.2.

C405.10.5 Graphical energy report A permanent and readily accessible reporting mechanism shall be provided in the building that is accessible by building operation and management personnel. The reporting mechanism shall have the capability to graphically provide the energy consumption for each end-use category required by Section C405.10.2 at least every hour, day, month, and year for the previous 36 months.

Reason: The investment made for the infrastructure of a building to comply with the IECC is significant. The assumption that is currently made upon commissioning a facility is that energy efficiency measures will not degrade, or go out of calibration, over time and their energy consumption will not increase as time passes from the time they were commissioned. Such as assumption is completely inaccurate and any payback assumed for energy efficient infrastructure investments will be lengthened, thereby reducing the ROI and increasing the payback period. The only means to retain the energy performance of a building is to continuously monitor energy consumption levels of various energy consuming systems and compare them to previous levels. Monitoring sub-systems provides key indications when changes have been made or systems are not operating to specification, which increases energy consumption. Examples include, but are not limited to:

1. Increase energy consumption in HVAC system loads will point to failures in motors, drive systems, bearings, etc.
2. Degrading building envelope.
3. Configuration changes to the building that may drive increased energy consumption.
4. Increase of energy consumption from lighting loads may indicate changes in arrangement of the office space that resulted in reduced lighting driving the installation of more lighting above permitted energy code levels, failure of occupant sensors, inappropriate lighting schedules, lamps that need to be replaced or cleaned, etc.

5. Monitoring plug loads will indicate when computer equipment is left on during non-working hours and use of space heaters that compromise the efficiency of the facility due to set points on the HVAC system.

The requirements in this proposal save energy by continually monitoring and reporting actionable energy consumption data to building owners and operators. For large buildings, this data is further broken out by the major sub-systems (HVAC, lighting, process loads, and plus loads). There are well documented studies that demonstrates the energy savings from metering and monitoring systems. The 2013 version of ASHRAE Std. 90.1 and several state energy codes have recognized the benefits and require energy monitoring to support a continual high level of performance from the energy efficient investment.

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

The code change proposal “will” increase the cost of construction because it will require additional hardware, software and labor during installation. Providing specific cost would violate antitrust laws, however the following link to a report provided by the GSA demonstrates an example of cost and savings:

https://www.gsa.gov/cdnstatic/Energy_Submetering_Finance_Paper_Knetwork_2012_11_269%28508%29.pdf

Proposal # 4406

CE215-19

CE216-19

IECC: C405.10 (New)

Proponent: Marilyn Williams, representing National Electrical Manufacturers Association

2018 International Building Code

Add new text as follows:

C405.10 Automatic Receptacle Control The following shall be automatically controlled:

1. At least 50% of all 125 V, 15 and 20-amp receptacles installed in enclosed offices, conference rooms, rooms used primarily for copy or print functions, breakrooms, classrooms, and individual workstations, including those installed in modular partitions and module office workstation systems.
2. At least 25% of branch circuit feeders installed for modular furniture not shown on the construction documents.
3. Either split controlled receptacles shall be provided, with the top receptacle controlled, or a controlled receptacle shall be located within 12 inches of each uncontrolled receptacle.

This control shall function on:

1. A scheduled basis using a time-of-day operated control device that turns receptacle power off at specific programmed times and can be programmed separately for each day of the week. The control device shall be configured to provide an independent schedule for each portion of the building of not more than 5000 ft² and not more than one floor. The occupant shall be able to manually override an area for not more than two hours. Any individual override switch shall control the receptacles of not more than 5000 ft.
2. An occupant sensor control that shall turn receptacles off within 20 minutes of all occupants leaving a space; or
3. An automated signal from another control or alarm system that shall turn receptacles off within 20 minutes after determining that the area is unoccupied.

All controlled receptacles shall be permanently marked in accordance with NFPA 70 and be uniformly distributed throughout the space. Plug-in devices shall not comply.

Exceptions: Receptacles for the following shall not require an automatic control device:

1. Receptacles specifically designated for equipment requiring continuous operation (24/day, 365 days/year).
2. Spaces where an automatic control would endanger the safety or security of the room or building occupants.
3. Within a single modular office workstation, non-controlled receptacles are permitted to be located more than 12 inches, but not more than 72 inches from the controlled receptacles serving that workstation.

Reason: This proposal will:

1. Increase building energy efficiency
2. Offer a well-studied, cost effective efficiency measure

3. Maintain building occupant's safe usability
4. Keep enforceability simple
5. Align with other energy efficiency codes, increasing design compliance.

Cost Impact: The code change proposal will increase the cost of construction. Costs estimated to be \$0.26/ft² for small office implementation and \$0.19/ft² for large office. Payback estimated at 4.2 years for small office buildings (10,000sqft) and 2.4 years for large office buildings (100,000sqft). Source: 2013 California Building Energy Efficiency Standards CASE report.

Proposal # 4316

CE216-19

CE217-19 Part I

PART I — IECC: C202, C405.10 (New), C405.10.1 (New), TABLE C405.10.1 (New), C405.10.2 (New)

PART II — IECC: R202 (IRC N1101.6), R404.2 (IRC N1104.2) (New), R404.2.1 (IRC N1104.2.1) (New), R404.2.2 (IRC N1104.2.2) (New), Table R404.2.2 (IRC N1104.2.2) (New), R404.2.3 (IRC N1104.2.3) (New)

Proponent: Matt Frommer, Southwest Energy Efficiency Project, representing Southwest Energy Efficiency Project (mfrommer@swenergy.org); Eric Makela, New Buildings Institute, representing New Buildings Institute (ericM@newbuildings.org); jim edelson, representing New Buildings Institute (jim@newbuildings.org); Steven Rosenstock, representing Edison Electric Institute (rosenstock@eei.org); Francesca Wahl (fwahl@tesla.com); Daniel Bresette, Alliance to Save Energy, representing Alliance to Save Energy (dbresette@ase.org)

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

2018 International Energy Conservation Code

Add new definition as follows:

ELECTRIC VEHICLE SUPPLY EQUIPMENT (EVSE). The conductors, including the ungrounded, grounded, and equipment grounding conductors, and the Electric Vehicle connectors, attachment plugs, and all other fittings, devices, power outlets, or apparatus installed specifically for the purpose of transferring energy between the premises wiring and the Electric Vehicle.

EV CAPABLE SPACE. Electrical panel capacity and space to support a minimum 40-ampere, 208/240-volt branch circuit for each EV parking space, and the installation of raceways, both underground and surface mounted, to support the *EVSE*.

EV READY SPACE. A designated parking space which is provided with one 40-ampere, 208/240-volt dedicated branch circuit for EVSE servicing *Electric Vehicles*. The circuit shall terminate in a suitable termination point such as a receptacle, junction box, or an *EVSE*, and be located in close proximity to the proposed location of the EV parking spaces.

Add new text as follows:

C405.10. Electric Vehicle (EV) charging for new construction. New construction shall facilitate future installation and use of *Electric Vehicle Supply Equipment (EVSE)* in accordance with the NFPA 70.

C405.10.1. New commercial buildings. *EV Ready Spaces* and *EV Capable Spaces* shall be provided in accordance with Table C405.10.1. Where the calculation of percent served results in a fractional parking space, it shall be rounded up to the next whole number. The service panel or sub panel circuit directory shall identify the spaces reserved to support EV charging as “EV Capable” or “EV Ready”. The raceway location shall be permanently and visibly marked as “EV Capable”.

TABLE C405.10.1.
EV READY SPACE AND EV CAPABLE SPACE REQUIREMENTS

<u>Total Number of Parking Spaces</u>	<u>Minimum number of EV Ready Spaces</u>	<u>Minimum number of EV Capable Spaces</u>
<u>1</u>	<u>1</u>	<u>=</u>

<u>2 – 10</u>	<u>2</u>	<u>=</u>
<u>11 – 15</u>	<u>2</u>	<u>3</u>
<u>16 – 19</u>	<u>2</u>	<u>4</u>
<u>21 - 25</u>	<u>2</u>	<u>5</u>
<u>26+</u>	<u>2</u>	<u>20% of total parking spaces</u>

C405.10.2. Identification. Construction documents shall indicate the raceway termination point and proposed location of future EV spaces and EV chargers. Construction documents shall also provide information on amperage of future *EVSE*, raceway methods, wiring schematics and electrical load calculations to verify that the electrical panel service capacity and electrical system, including any on-site distribution transformers, have sufficient capacity to simultaneously charge all EVs at all required EV spaces at the full rated amperage of the *EVSE*.

Proposal # 4968

CE217-19 Part I

CE217-19 Part II

IECC: R202 (IRC N1101.6), R404.2 (IRC N1104.2) (New), R404.2.1 (IRC N1104.2.1) (New), R404.2.2 (IRC N1104.2.2) (New), Table R404.2.2 (IRC N1104.2.2) (New), R404.2.3 (IRC N1104.2.3) (New)

Proponent: Matt Frommer, Southwest Energy Efficiency Project, representing Southwest Energy Efficiency Project (mfrommer@swenergy.org); Eric Makela, New Buildings Institute, representing New Buildings Institute (ericM@newbuildings.org); jim edelson, representing New Buildings Institute (jim@newbuildings.org); Steven Rosenstock, representing Edison Electric Institute (srosenstock@eei.org); Daniel Bresette, Alliance to Save Energy, representing Alliance to Save Energy (dbresette@ase.org); Francesca Wahl (fwahl@tesla.com)

2018 International Energy Conservation Code

SECTION R202 (IRC N1101.6) GENERAL DEFINITIONS

Add new definition as follows:

ELECTRIC VEHICLE SUPPLY EQUIPMENT (EVSE). The conductors, including the ungrounded, grounded, and equipment grounding conductors, and the Electric Vehicle connectors, attachment plugs, and all other fittings, devices, power outlets, or apparatus installed specifically for the purpose of transferring energy between the premises wiring and the Electric Vehicle.

EV CAPABLE SPACE. Electrical panel capacity and space to support a minimum 40-ampere, 208/240-volt branch circuit for each EV parking space, and the installation of raceways, both underground and surface mounted, to support the *EVSE*.

EV READY SPACE. A designated parking space which is provided with one 40-ampere, 208/240-volt dedicated branch circuit for *EVSE* servicing Electric Vehicles. The circuit shall terminate in a suitable termination point such as a receptacle, junction box, or an *EVSE*, and be located in close proximity to the proposed location of the EV parking spaces.

Add new text as follows:

R404.2 (IRC N1104.2) Electric Vehicle (EV) charging for new construction. New construction shall facilitate future installation and use of *Electric Vehicle Supply Equipment (EVSE)* in accordance with the *National Electrical Code (NFPA 70)*.

R404.2.1 (IRC N1104.2.1) One- to two-family dwellings and townhouses. For each dwelling unit, provide at least one *EV Ready Space*. The branch circuit shall be identified as “EV Ready” in the service panel or subpanel directory, and the termination location shall be marked as “EV Ready”.

Exception: *EV Ready Spaces* are not required where no parking spaces are provided.

R404.2.2 (IRC N1104.2.2) Multifamily dwellings (three or more units). *EV Ready Spaces* and *EV Capable Spaces* shall be provided in accordance with Table R404.2.2. Where the calculation of percent served results in a fractional parking space, it shall round up to the next whole number. The service panel or subpanel circuit directory shall identify the spaces reserved to support EV charging as “EV Capable” or “EV Ready”. The raceway location shall be permanently and visibly marked as “EV Capable”.

Table R404.2.2 (IRC N1104.2.2)
EV Ready Space and EV Capable Space requirements.

<u>Total Number of Parking Spaces</u>	<u>Minimum number of <i>EV Ready</i> Spaces</u>	<u>Minimum number of <i>EV Capable</i> Spaces</u>
<u>1</u>	<u>1</u>	<u>1</u>
<u>2 – 10</u>	<u>2</u>	<u>1</u>
<u>11 – 15</u>	<u>2</u>	<u>3</u>
<u>16 – 19</u>	<u>2</u>	<u>4</u>
<u>21 - 25</u>	<u>2</u>	<u>5</u>
<u>26+</u>	<u>2</u>	<u>20% of total parking spaces</u>

R404.2.3 (IRC N1104.2.3) Identification. Construction documents shall indicate the raceway termination point and proposed location of future EV spaces and EV chargers. Construction documents shall also provide information on amperage of future *EVSE*, raceway methods, wiring schematics and electrical load calculations to verify that the electrical panel service capacity and electrical system, including any on-site distribution transformers, have sufficient capacity to simultaneously charge all EVs at all required EV spaces at the full rated amperage of the *EVSE*.

Reason: In the United States, electric vehicle (EV) sales increased by 80 percent from 2017 to 2018 (1). According to a November 2018 forecast from the Edison Electric Institute, the number of EVs on U.S. roads is projected to grow from 1 million vehicles at the end of 2018, to 18.7 million by 2030. To recharge these new EVs, the U.S. will need 9.6 million charge ports, a substantial portion of which will be installed in single and multi-family residential buildings (2).

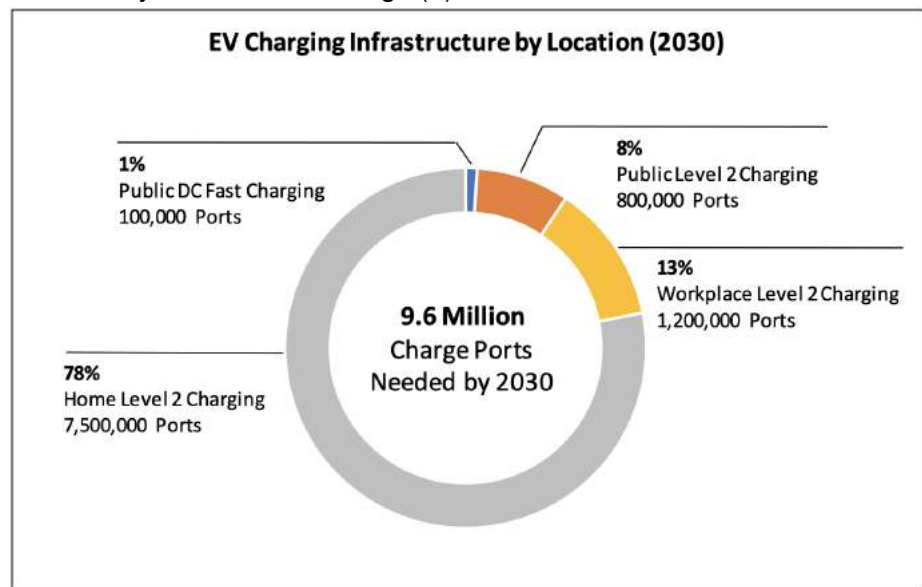


Figure 1. EV Charging Infrastructure in 2030 Based on EEI/IEI Forecast.

EVs provide significant economic benefits for consumers through fuel and maintenance cost savings, and have been identified as a key climate strategy to reduce GHG emissions from the U.S. transportation sector. The interest in EVs has grown alongside greater EV model availability and increased vehicle range. Every major auto manufacturer in the world has announced a plan to electrify a significant portion of their vehicle fleets over the next 3-5 years. Ford recently announced an \$11 billion investment to reach their goal of 40 EV models by 2022 (3). The goal for GM: 20 EV models by 2023 (4); for VW: 27 EV models by 2022 (5); for Toyota: 10 BEVs by the early 2020's (6); and similar goals for Volvo, Daimler, Nissan, BMW, and Fiat-Chrysler.

However, the lack of access to EV charging stations continues to be a critical barrier to EV adoption. In particular, there are significant logistical barriers for residents of multi-family dwellings to upgrade existing electrical infrastructure and install new EV charging stations.

A lack of pre-existing EV charging infrastructure, such as electrical panel capacity, raceways, and pre-wiring, can make the installation of a new charging station cost-prohibitive for a potential EV-owner. The installation of an EV charging station is made three to four times less expensive when the infrastructure is installed during the initial construction phase as opposed to retrofitting existing buildings to accommodate the new electrical equipment.

New residential buildings are constructed to last for decades, and so it is critical that EV charging infrastructure is incorporated at the pre-construction stage to ensure that new buildings can accommodate the charging needs of future EV-owners.

Bibliography:

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8. *ELECTRIC VEHICLE (EV) CHARGING INFRASTRUCTURE: MULTIFAMILY BUILDING STANDARDS*. Report. April 2018. Accessed January 2019. <https://arb.ca.gov/cc/greenbuildings/pdf/tcac2018.pdf>.
9. "NFPA 70®." NFPA Reports - Fires in the United States. Accessed January 2019. <https://www.nfpa.org/codes-and-standards/all-codes-and-standards/list-of-codes-and-standards/detail?code=70>.

Cost Impact: The code change proposal will increase the cost of construction. The code change proposal will increase the cost of initial construction, but provide long-term savings for EV owners through the avoided retrofit costs of installing EV charging infrastructure.

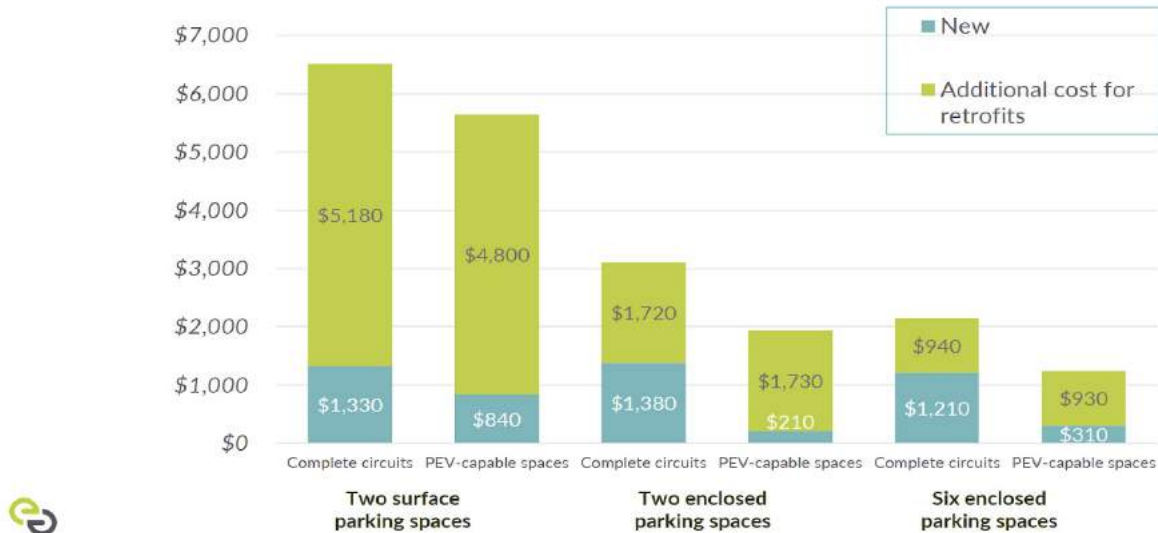
One- and two- family dwellings: additional costs include the price and labor associated with the installation of one 40-ampere, 208/240-volt dedicated branch circuit and a circuit terminating in a receptacle, junction box, or EVSE. The proposed code will allow current and future EV-owners to avoid the cost of electrical equipment upgrades, demolition, and permitting for future retrofits.

Multi-family residential (3 or more units): The chart below compares the cost of installing the necessary electrical infrastructure to support EV-Ready spaces (complete circuit) and an EV-Capable spaces (PEV-capable) at the time of new construction versus a building retrofit. In one example, the cost estimate to retrofit

an existing building with two EV-Capable spaces is \$5,640, and \$4,800 or 85 percent of that cost would be avoided if EV-Capable infrastructure was included during the initial construction of the parking lot. These additional retrofit costs typically include labor expenses for demolition, treching and boring, balancing the circuits, and new permitting costs.

Why Adopt EV Infrastructure Building Codes?

Cost Savings Modeled for the City of Oakland



In April, 2018, the California Air Resources Board published a cost analysis for a proposed code change to increase the required percentage of EV-Capable spaces. (8)

“Avoided Retrofit Costs: Significant retrofit costs can be avoided by installing EV charging infrastructure in new construction. CARB staff reviewed multiple sources to obtain average retrofit costs of installing infrastructure to support Level 2 charging stations in existing buildings. An estimated \$7,000 per parking space can be avoided with multiple installations of Level 2 charging stations. An estimated \$8,000 per parking space can be avoided when an individual Level 2 charging station is installed. These retrofit costs do not include the cost of the electrical vehicle supply equipment (EVSE). Retrofit costs are focused on parking lot trenching, adding electrical service and/or panel upgrades. The 10 percent requirement would result in the installation of an additional 38,000 to 47,000 parking spaces with EV charging infrastructure beyond the current 3 percent requirement. If the proposed 10% requirement is not adopted, CARB staff assumed that every one of these parking spaces would need the basic EV charging infrastructure (raceway and panel capacity) to become EV Capable and support future installation of Level 2 charging stations. CARB staff estimates that the avoided retrofit costs range from \$272 million to \$386 million between 2020 and 2025.”

Proposal # 4701

CE217-19 Part II

CE218-19

IECC: SECTION C406 (New), C406.1 (New), C406.1 (New), C406.1.1 (New), C406.2 (New), C406.2.1 (New), C406.2.2 (New), C406.2.3 (New), C406.2.4 (New), C406.3, C406.3.2 (New), C406.5, C406.5.2 (New), C406.7, C406.7.1, C406.7.3 (New), C406.7.4 (New)

Proponent: Eric Makela, New Buildings Institute, representing Northwest Energy Codes Group
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2018 International Energy Conservation Code

Revise as follows:

SECTION C406 ADDITIONAL EFFICIENCY PACKAGE OPTIONS REQUIREMENTS

C406.1 Requirements. ~~Additional energy efficiency credit requirements.~~ Buildings shall comply with one or more of the following:

- ~~1. More efficient HVAC performance in accordance with Section C406.2.~~
- ~~2. Reduced lighting power in accordance with Section C406.3.~~
- ~~3. Enhanced lighting controls in accordance with Section C406.4.~~
- ~~4. On-site supply of renewable energy in accordance with Section C406.5.~~
- ~~5. Provision of a dedicated outdoor air system for certain HVAC equipment in accordance with Section C406.6.~~
- ~~6. High efficiency service water heating in accordance with Section C406.7.~~
- ~~7. Enhanced envelope performance in accordance with Section C406.8.~~
- ~~8. Reduced air infiltration in accordance with Section C406.9.~~

New buildings shall achieve a total of 10 credits from Tables C406.1(1) through C406.1(5). Where a building contains multiple use groups, credits from each use group shall be weighted by floor area of each group to determine the weighted average building credit.

Add new text as follows:

C406.1

Table C406.1(1) Additional Energy Efficiency Credits for Group B Occupants

Climate Zone:	1A	1B	2A	2B	3A	3B	3C	4A	4B	4C	5A	5B	5C	6A	6B	7	8
C406.2.1: 5% Heating	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1	NA	NA	1	1	NA	1
C406.2.2: 5% Cooling	6	6	5	5	4	4	3	3	3	2	2	2	1	2	2	2	1
C406.2.3: 10% Heating	NA	NA	NA	NA	NA	NA	NA	1	NA	NA	2	1	1	2	2	NA	1
C406.2.4: 10% Cooling	11	12	10	9	7	7	6	5	6	4	4	5	3	4	3	3	3
C406.3.1: 10% LPA	9	8	9	9	9	9	10	8	9	9	7	8	8	6	7	7	6
C406.4: Digital Lt Ctrl	2	2	2	2	2	2	2	2	2	2	2	2	2	1	2	1	1
C406.5: Renewable	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9
C406.6: DOAS	4	4	4	4	4	3	2	5	3	2	5	3	2	7	4	5	3
C406.7.1: SWH HR	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
C406.7.2: SWH NG eff	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
C406.7.3: SWH HP	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
C406.8: 85% UA	1	4	2	4	4	3	NA	7	4	5	10	7	6	11	10	14	16

C406.9: Low Leak	<u>2</u>	<u>1</u>	<u>1</u>	<u>2</u>	<u>4</u>	<u>1</u>	<u>NA</u>	<u>8</u>	<u>2</u>	<u>3</u>	<u>11</u>	<u>4</u>	<u>1</u>	<u>15</u>	<u>8</u>	<u>11</u>	<u>6</u>
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C406.1

Table C406.1(2) Additional Energy Efficiency Credits for Group R and I Occupancies

Climate Zone:	<u>1A</u>	<u>1B</u>	<u>2A</u>	<u>2B</u>	<u>3A</u>	<u>3B</u>	<u>3C</u>	<u>4A</u>	<u>4B</u>	<u>4C</u>	<u>5A</u>	<u>5B</u>	<u>5C</u>	<u>6A</u>	<u>6B</u>	<u>7</u>	<u>8</u>
C406.2.1: 5% Heating	<u>NA</u>	<u>NA</u>	<u>NA</u>	<u>NA</u>	<u>1</u>	<u>NA</u>	<u>NA</u>	<u>1</u>	<u>NA</u>	<u>1</u>	<u>1</u>	<u>1</u>	<u>1</u>	<u>2</u>	<u>1</u>	<u>2</u>	<u>2</u>
C406.2.2: 5% Cooling	<u>3</u>	<u>3</u>	<u>2</u>	<u>2</u>	<u>1</u>	<u>1</u>	<u>1</u>	<u>1</u>	<u>1</u>	<u>NA</u>	<u>1</u>	<u>1</u>	<u>NA</u>	<u>1</u>	<u>1</u>	<u>1</u>	<u>NA</u>
C406.2.3: 10% Heating	<u>NA</u>	<u>NA</u>	<u>NA</u>	<u>NA</u>	<u>1</u>	<u>NA</u>	<u>NA</u>	<u>1</u>	<u>1</u>	<u>1</u>	<u>2</u>	<u>2</u>	<u>1</u>	<u>3</u>	<u>2</u>	<u>3</u>	<u>4</u>
C406.2.4: 10% Cooling	<u>5</u>	<u>5</u>	<u>4</u>	<u>3</u>	<u>2</u>	<u>3</u>	<u>1</u>	<u>2</u>	<u>2</u>	<u>1</u>	<u>1</u>	<u>1</u>	<u>1</u>	<u>1</u>	<u>1</u>	<u>1</u>	<u>1</u>
C406.3.1: 10% LPA	<u>2</u>	<u>2</u>	<u>2</u>	<u>2</u>	<u>2</u>	<u>2</u>	<u>3</u>	<u>2</u>	<u>2</u>	<u>2</u>	<u>2</u>	<u>2</u>	<u>2</u>	<u>2</u>	<u>2</u>	<u>2</u>	<u>2</u>
C406.4: Digital Lt Ctrl	<u>NA</u>	<u>NA</u>	<u>NA</u>	<u>NA</u>	<u>NA</u>	<u>NA</u>	<u>NA</u>	<u>NA</u>	<u>NA</u>	<u>NA</u>	<u>NA</u>	<u>NA</u>	<u>NA</u>	<u>NA</u>	<u>NA</u>	<u>NA</u>	<u>NA</u>
C406.5: Renewable	<u>8</u>	<u>8</u>	<u>8</u>	<u>8</u>	<u>7</u>	<u>8</u>	<u>8</u>	<u>7</u>	<u>7</u>	<u>7</u>	<u>7</u>	<u>7</u>	<u>7</u>	<u>7</u>	<u>7</u>	<u>7</u>	<u>7</u>
C406.6: DOAS	<u>3</u>	<u>4</u>	<u>3</u>	<u>3</u>	<u>4</u>	<u>2</u>	<u>NA</u>	<u>6</u>	<u>3</u>	<u>4</u>	<u>8</u>	<u>5</u>	<u>5</u>	<u>10</u>	<u>7</u>	<u>11</u>	<u>12</u>
C406.7.1: SWH HR	<u>10</u>	<u>9</u>	<u>11</u>	<u>10</u>	<u>13</u>	<u>12</u>	<u>15</u>	<u>14</u>	<u>14</u>	<u>15</u>	<u>14</u>	<u>14</u>	<u>16</u>	<u>14</u>	<u>15</u>	<u>15</u>	<u>15</u>
C406.7.2: SWH NG eff	<u>5</u>	<u>5</u>	<u>6</u>	<u>6</u>	<u>8</u>	<u>7</u>	<u>8</u>	<u>8</u>	<u>8</u>	<u>9</u>	<u>9</u>	<u>9</u>	<u>10</u>	<u>10</u>	<u>9</u>	<u>10</u>	<u>11</u>
C406.7.3: SWH HP	<u>6</u>	<u>5</u>	<u>5</u>	<u>5</u>	<u>5</u>	<u>5</u>	<u>5</u>	<u>5</u>	<u>5</u>	<u>5</u>	<u>5</u>	<u>5</u>	<u>5</u>	<u>5</u>	<u>5</u>	<u>5</u>	<u>5</u>
C406.8: 85% UA	<u>3</u>	<u>6</u>	<u>3</u>	<u>5</u>	<u>4</u>	<u>4</u>	<u>1</u>	<u>4</u>	<u>3</u>	<u>3</u>	<u>4</u>	<u>5</u>	<u>3</u>	<u>5</u>	<u>4</u>	<u>6</u>	<u>6</u>
C406.9: Low Leak	<u>6</u>	<u>5</u>	<u>3</u>	<u>11</u>	<u>6</u>	<u>4</u>	<u>NA</u>	<u>7</u>	<u>3</u>	<u>3</u>	<u>9</u>	<u>5</u>	<u>1</u>	<u>13</u>	<u>6</u>	<u>8</u>	<u>3</u>

C406.1

Table C406.1(3) Additional Energy Efficiency Credits for Group E Occupancies

Climate Zone:	<u>1A</u>	<u>1B</u>	<u>2A</u>	<u>2B</u>	<u>3A</u>	<u>3B</u>	<u>3C</u>	<u>4A</u>	<u>4B</u>	<u>4C</u>	<u>5A</u>	<u>5B</u>	<u>5C</u>	<u>6A</u>	<u>6B</u>	<u>7</u>	<u>8</u>
C406.2.1: 5% Heating	<u>NA</u>	<u>NA</u>	<u>NA</u>	<u>NA</u>	<u>1</u>	<u>1</u>	<u>1</u>	<u>1</u>	<u>1</u>	<u>2</u>	<u>1</u>	<u>2</u>	<u>1</u>	<u>2</u>	<u>2</u>	<u>3</u>	<u>4</u>
C406.2.2: 5% Cooling	<u>4</u>	<u>4</u>	<u>3</u>	<u>3</u>	<u>2</u>	<u>2</u>	<u>2</u>	<u>2</u>	<u>1</u>	<u>1</u>	<u>1</u>	<u>1</u>	<u>NA</u>	<u>1</u>	<u>1</u>	<u>1</u>	<u>NA</u>
C406.2.3: 10% Heating	<u>NA</u>	<u>NA</u>	<u>NA</u>	<u>1</u>	<u>1</u>	<u>1</u>	<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>	<u>3</u>	<u>4</u>	<u>3</u>	<u>4</u>	<u>3</u>	<u>5</u>	<u>7</u>
C406.2.4: 10% Cooling	<u>7</u>	<u>8</u>	<u>7</u>	<u>6</u>	<u>5</u>	<u>4</u>	<u>3</u>	<u>4</u>	<u>3</u>	<u>1</u>	<u>2</u>	<u>2</u>	<u>1</u>	<u>2</u>	<u>2</u>	<u>2</u>	<u>1</u>
C406.3.1: 10% LPA	<u>8</u>	<u>8</u>	<u>8</u>	<u>9</u>	<u>8</u>	<u>9</u>	<u>9</u>	<u>8</u>	<u>9</u>	<u>9</u>	<u>8</u>	<u>9</u>	<u>8</u>	<u>7</u>	<u>8</u>	<u>7</u>	<u>7</u>
C406.4: Digital Lt Ctrl	<u>2</u>	<u>2</u>	<u>2</u>	<u>2</u>	<u>2</u>	<u>2</u>	<u>2</u>	<u>2</u>	<u>2</u>	<u>2</u>	<u>2</u>	<u>3</u>	<u>2</u>	<u>2</u>	<u>2</u>	<u>2</u>	<u>1</u>
C406.5: Renewable	<u>6</u>	<u>6</u>	<u>6</u>	<u>6</u>	<u>6</u>	<u>6</u>	<u>6</u>	<u>6</u>	<u>6</u>	<u>6</u>	<u>6</u>	<u>6</u>	<u>6</u>	<u>6</u>	<u>6</u>	<u>5</u>	<u>5</u>
C406.6: DOAS	<u>NA</u>	<u>NA</u>	<u>NA</u>	<u>NA</u>	<u>NA</u>	<u>NA</u>	<u>NA</u>	<u>NA</u>	<u>NA</u>	<u>NA</u>	<u>NA</u>	<u>NA</u>	<u>NA</u>	<u>NA</u>	<u>NA</u>	<u>NA</u>	<u>NA</u>
C406.7.1: SWH HR*	<u>1</u>	<u>1</u>	<u>1</u>	<u>1</u>	<u>1</u>	<u>1</u>	<u>1</u>	<u>1</u>	<u>1</u>	<u>1</u>	<u>1</u>	<u>1</u>	<u>1</u>	<u>1</u>	<u>1</u>	<u>1</u>	<u>1</u>
C406.7.2: SWH NG eff*	<u>NA</u>	<u>1</u>	<u>1</u>	<u>1</u>	<u>1</u>	<u>1</u>	<u>1</u>	<u>2</u>	<u>2</u>	<u>3</u>	<u>2</u>	<u>3</u>	<u>2</u>	<u>3</u>	<u>3</u>	<u>3</u>	<u>5</u>
C406.7.3: SWH HPWH*	<u>NA</u>	<u>NA</u>	<u>NA</u>	<u>NA</u>	<u>NA</u>	<u>NA</u>	<u>NA</u>	<u>1</u>	<u>NA</u>	<u>NA</u>	<u>1</u>	<u>1</u>	<u>NA</u>	<u>1</u>	<u>1</u>	<u>1</u>	<u>1</u>
C406.8: 85% UA	<u>3</u>	<u>7</u>	<u>3</u>	<u>4</u>	<u>2</u>	<u>4</u>	<u>1</u>	<u>1</u>	<u>3</u>	<u>1</u>	<u>2</u>	<u>3</u>	<u>NA</u>	<u>4</u>	<u>3</u>	<u>6</u>	<u>9</u>
C406.9: Low Leak	<u>1</u>	<u>1</u>	<u>1</u>	<u>2</u>	<u>NA</u>	<u>NA</u>	<u>NA</u>	<u>NA</u>	<u>NA</u>	<u>NA</u>	<u>1</u>	<u>NA</u>	<u>NA</u>	<u>4</u>	<u>1</u>	<u>4</u>	<u>3</u>

* for schools with full service kitchens or showers

C406.1

Table C406.1(4) Additional Energy Efficiency Credits for Group M Occupancies

Climate Zone:	1A	1B	2A	2B	3A	3B	3C	4A	4B	4C	5A	5B	5C	6A	6B	7	8
C406.2.1: 5% Heating	NA	NA	NA	NA	1	1	NA	1	1	2	2	2	2	3	2	3	4
C406.2.2: 5% Cooling	5	6	4	4	3	3	1	2	2	1	1	2	NA	1	1	1	NA
C406.2.3: 10% Heating	NA	NA	NA	1	1	1	1	2	2	4	3	4	5	5	3	6	8
C406.2.4: 10% Cooling	9	12	9	8	6	6	3	4	4	1	2	3	NA	2	2	2	1
C406.3.1: 10% LPA	13	13	15	14	16	14	17	15	15	14	12	14	14	16	16	14	12
C406.4: Digital Lt Ctrl	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
C406.5: Renewable	8	8	8	8	8	8	8	8	8	7	7	7	7	7	7	7	6
C406.6: DOAS	3	4	3	3	3	3	1	3	2	2	2	3	2	4	3	4	4
C406.7.1: SWH HR	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
C406.7.2: SWH NG eff	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
C406.7.3: SWH HP	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
C406.8: 85% UA	4	6	3	4	3	3	1	6	4	4	4	5	4	6	5	8	9
C406.9: Low Leak Env	1	1	1	2	1	1	NA	3	1	1	3	2	1	7	3	6	3

C406.1

Table C406.1(5) Additional Energy Efficiency Credits for Other* Occupancies

Climate Zone:	1A	1B	2A	2B	3A	3B	3C	4A	4B	4C	5A	5B	5C	6A	6B	7	8
C406.2.1: 5% Heating	NA	NA	NA	NA	1	1	1	1	1	2	1	2	1	2	2	3	3
C406.2.2: 5% Cooling	5	5	4	4	3	3	2	2	2	1	1	2	1	1	1	1	1
C406.2.3: 10% Heating	NA	NA	NA	1	1	1	1	2	2	3	3	3	3	4	3	5	5
C406.2.4: 10% Cooling	8	9	8	7	5	5	3	4	4	2	2	3	2	2	2	2	2
C406.3.1: 10% LPA	8	8	9	9	9	9	10	8	9	9	7	8	8	8	8	8	7
C406.4: Digital Lt Ctrl	2	2	2	2	2	2	2	2	2	2	2	3	2	2	2	2	1
C406.5: Renewable	8	8	8	8	8	8	8	8	8	7	7	7	7	7	7	7	7
C406.6: DOAS	3	4	3	3	4	3	2	5	3	3	5	4	3	7	5	7	6
C406.7.1: SWH HR**	10	9	11	10	13	12	15	14	14	15	14	14	16	14	15	15	15
C406.7.2: SWH FF eff**	5	5	6	6	8	7	8	8	8	9	9	9	10	10	9	10	11
C406.7.3: SWH HPWH**	6	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
C406.8: 85% UA	3	6	3	4	3	4	1	5	4	3	5	5	4	7	6	9	10
C406.9: Low Leak Env	3	2	2	4	4	2	NA	6	2	2	6	4	1	10	5	7	4

* Other occupancy groups include all Groups except for Groups B, R, I, E, and M.

** for occupancy groups listed in C406.7.1

Revise as follows:

C406.1.1 Tenant spaces. Tenant spaces shall comply with sufficient options from Tables C406.1(1) through C406.1(5) to achieve a minimum number of 5 credits, where credits are selected from Section C406.2, C406.3, C406.4, C406.6 or C406.7. Alternatively Where the entire building complies using credits from Section C406.5, C406.8 or C406.9, tenant spaces within the building shall be deemed to comply with Section C406.5 where the

~~entire building is in compliance, this section.~~

Exception: Previously occupied tenant spaces that comply with this code in accordance with Section C501.

C406.2 More efficient HVAC equipment performance. Equipment shall exceed the minimum efficiency requirements listed in Tables C403.3.2(1) through C403.3.2(7) ~~by 10 percent, in addition to the requirements of Section C403. Where multiple performance requirements are provided, the equipment shall exceed all requirements by 10 percent.~~ 9) and Variable refrigerant flow systems shall exceed listed in the energy efficiency provisions of ANSI/ASHRAE/IESNA 90.1 by 10 percent, in accordance with Sections C406.2.1, C406.2, C406.2.3 or C406.4. Equipment shall also meet applicable requirements of Section C403. Energy efficiency credits for heating shall be selected from C406.2.1 or C406.2.3 and energy efficiency credits for cooling shall be selected from C406.2.2 or C406.2.4. Selected credits shall include a heating or cooling energy efficiency credit or both. Equipment not listed in Tables C403.3.2(1) through C403.3.2(7) 9) and Variable refrigerant flow systems not listed in the energy efficiency provisions of ANSI/ASHRAE/IES 90.1 shall be limited to 10 percent of the total building system capacity, capacity for heating equipment where selecting C406.2.1 or C406.2.3 and cooling equipment where selecting C406.2.2 or C406.2.4.

Add new text as follows:

C406.2.1 More efficient HVAC heating performance. Equipment shall exceed the minimum heating efficiency requirements by 5 percent.

C406.2.2 More efficient HVAC cooling performance. Equipment shall exceed the minimum cooling and heat rejection efficiency requirements by 5 percent. Where multiple cooling performance requirements are provided, the equipment shall exceed the annual energy requirement, including IEER, SEER, and IPLV.

C406.2.3 High efficiency HVAC heating performance. Equipment shall exceed the minimum heating efficiency requirements by 10 percent.

C406.2.4 High efficiency HVAC cooling performance. Equipment shall exceed the minimum cooling and heat rejection efficiency requirements by 10 percent. Where multiple cooling performance requirements are provided, the equipment shall exceed the annual energy requirement, including IEER, SEER, and IPLV.

Revise as follows:

C406.3 Reduced lighting power. Buildings shall comply with Section C406.3.1 or C406.3.2.

C406.3.1 Reduced lighting power 10 percent . The total connected interior lighting power calculated in accordance with Section C405.3.1 shall be less than 90 percent of the total lighting power allowance calculated in accordance with Section C405.3.2.

Add new text as follows:

C406.3.2 Reduced lighting power more than 15 percent. Where the total connected interior lighting power calculated in accordance with Section C405.3.1 is less than 85 percent of the total lighting power allowance calculated in accordance with Section C405.3.2, additional energy efficiency credits shall be determined based on Equation 4-12, rounded to the nearest whole number.

$AEEC_{LPA} = AEEC_{10} \times 10 \times (LPA - LPD) / LPA$ (Equation 4-12)

Where:

$AEEC_{LPA}$ = C406.3.2 additional energy efficiency credits

LPD = total connected interior lighting power calculated in accordance with Section C405.3.1

LPA = total lighting power allowance calculated in accordance with Section C405.3.2

AEEC₁₀ = C406.3.1 credits from Tables C406.1(1) through C406.1(5)

Revise as follows:

C406.5 On-site renewable energy. Buildings shall comply with Section C406.5.1 or C406.5.2.

C406.5.1 Basic Renewable Credits. The total minimum ratings of on-site renewable energy systems shall be one of the following:

1. Not less than ~~1.71-0.86~~ Btu/h per square foot (~~5.4-2.7~~ W/m²) or ~~0.50-0.25~~ watts per square foot (~~5.4-2.7~~ W/m²) of conditioned floor area.
2. Not less than 3 percent of the annual energy used within the building for building mechanical and service water heating equipment and lighting regulated in Chapter 4.

Add new text as follows:

C406.5.2 Enhanced Renewable Credits. Where the total minimum ratings of on-site renewable energy systems exceeds the rating in C406.5.1(1), additional energy efficiency credits shall be determined based on Equation 4-13, rounded to the nearest whole number.

$AEEC_{RRA} = AEEC_{2.5} \times RRA / RR_1$ (Equation 4-13)

Where:

$AEEC_{RRA}$ = C406.5.2 additional energy efficiency credits

RRA = actual total minimum ratings of on-site renewable energy systems in Btu/h, watts per square foot or W/m²

RR_1 = minimum ratings of on-site renewable energy systems required by C406.5.1(1) in Btu/h, watts per square foot or W/m² $AEEC_{2.5}$ = C406.5.1 credits from Tables C406.1(1) through C406.1(5)

Revise as follows:

C406.7 Reduced energy use in service water heating. Buildings shall comply with Sections C406.7.1 and either C406.7.2, C406.7.3 or C406.7.4.

C406.7.1 Building type. To qualify for this credit, the building shall contain one of shall be of the following use groups and the additional energy efficiency credit shall be prorated by conditioned floor area of the portion of the building comprised of the following use groups.

types to use this compliance method:

1. Group R-1: Boarding houses, hotels or motels.
2. Group I-2: Hospitals, psychiatric hospitals and nursing homes.
3. Group A-2: Restaurants and banquet halls or buildings containing food preparation areas.
4. Group F: Laundries.
5. Group R-2.
6. Group A-3: Health clubs and spas.
7. Group E: Schools with full-service kitchens or locker rooms with showers
8. Buildings showing a service hot water load of 10 percent or more of total building energy loads, as shown with an energy analysis as described in Section C407.

~~C406.7.1~~ C406.7.2 Load fraction.**Recovered or renewable water heating** The building service water-heating system shall have one or more of the following that are sized to provide not less than ~~60-30~~ percent of the building's annual hot water requirements, or sized to provide ~~40-70~~ percent of the building's annual hot water requirements if the building ~~shall otherwise be required to~~ comply with Section C403.9.5:

1. Waste heat recovery from service hot water, heat-recovery chillers, building equipment, or process equipment.
2. *On-site renewable energy* water-heating systems.

Add new text as follows:

C406.7.3 Efficient fossil fuel water heater. The combined input-capacity-weighted-average equipment rating of all fossil fuel water heating equipment in the building shall be not less than 95% Et or 0.95 EF. This option shall receive only half the listed credits for buildings required to comply with C404.2.1.

C406.7.4 Heat pump water heater. Where electric resistance water heaters are allowed, all service hot water system heating requirements shall be met using heat pump technology with a combined input-capacity-weighted-average EF of 3.0. Air-source heat pump water heaters shall not draw conditioned air from within the building, except exhaust air that would otherwise be exhausted to the exterior.

Reason: The C406 Option Packages was introduced into the IECC in 2012 as part of the prescriptive method to achieve an additional 4% energy savings over the prescriptive requirements of the code. The original proposal included three additional options (reduced lighting power density, increased HVAC efficiency and renewables). The 2018 IECC now has eight options to select from. In 2018, PNNL performed an analysis to determine the energy savings potential for each of the eight options and found significant savings differences.

How does the proposed measure compare to what's required in current codes?

The current additional efficiency package options are all considered equal in the 2018 IECC, and any one item must be selected to comply with the extra efficiency provision. However, there is a great deal of variation in the energy savings, as shown in Figure 1.

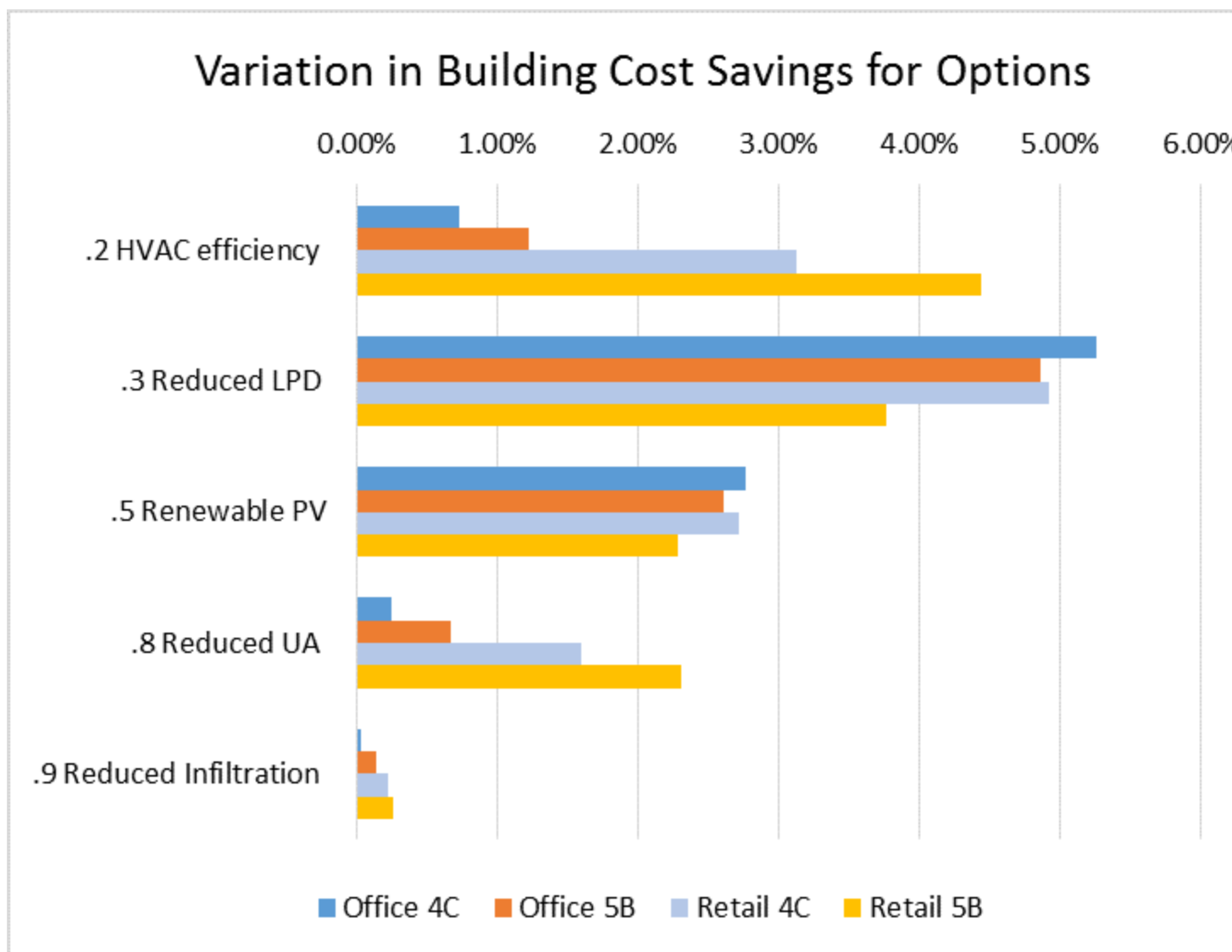


Figure [if supportFields]> SEQ Figure * ARABIC

To address this issue PNNL developed a points based option that provides equity across the efficiency measure options. The analysis is presented in their technical brief “Relative Credits for Extra Efficiency Measures”

C406 – Additional Efficiency Credits

http://www.pnnl.gov/main/publications/external/technical_reports/PNNL-28370.pdf

Technical Analysis

The technical analysis was conducted as follows:

- Prototype models are used in the analysis. Their development, and associated climate locations, are described in detail in the quantitative determination[1] and are available for download.[2] Four building prototypes were used to capture the difference between building types:

- Medium office

- Primary School

– Mid-rise Apartment

– Stand Alone Retail

EnergyPlus™ was used to evaluate each measure in the four prototypes in all U.S. climate zones, except in cases where there is not a strong interaction with building HVAC systems, where standard engineering calculations were used. This applies to service hot water and renewable energy. Dedicated outdoor air systems (DOAS) savings were estimated rather than modeled, as discussed in the “Relative Credits for Extra Efficiency Measures”.

- Using average annual commercial energy prices, cost savings for each measure are calculated as a percentage of building total annual energy cost.
- The cost percentages are converted to credit points, with the goal of not being exactly equivalent, but to provide approximate relative equivalency between measures. One point is assigned for each 0.25% of building energy cost savings.

Extra efficiency measures save energy by reducing energy use directly or reducing the heating or cooling loads in the building, resulting in lower HVAC energy use. The measure would require different items to be added to construction, depending on the combination of credits selected. The requirements for each measure are discussed under the individual items.

Why is an energy efficiency credit assignment method superior to other approaches?

The extra efficiency credit approach allows for designer and builder flexibility. While it is slightly more complicated to select multiple items and add up points, in many cases credit would be given for measures that are often included in buildings. Furthermore, using points rather than “just pick one” puts the options on more of a level consideration and better accounts for the impact of climate.

The climate zone impact is fairly broad, especially for cooling efficiency and building envelope measures. The spread is also broad for lighting reduction and plug load controls, as the reduced heat load must be made up by the heating system in colder climates, while in warmer climates there is added savings in the cooling system. Assigning the points relative to building energy cost savings and climate zone will reward savings measures appropriate to the location of the building, and more fairly across measures.

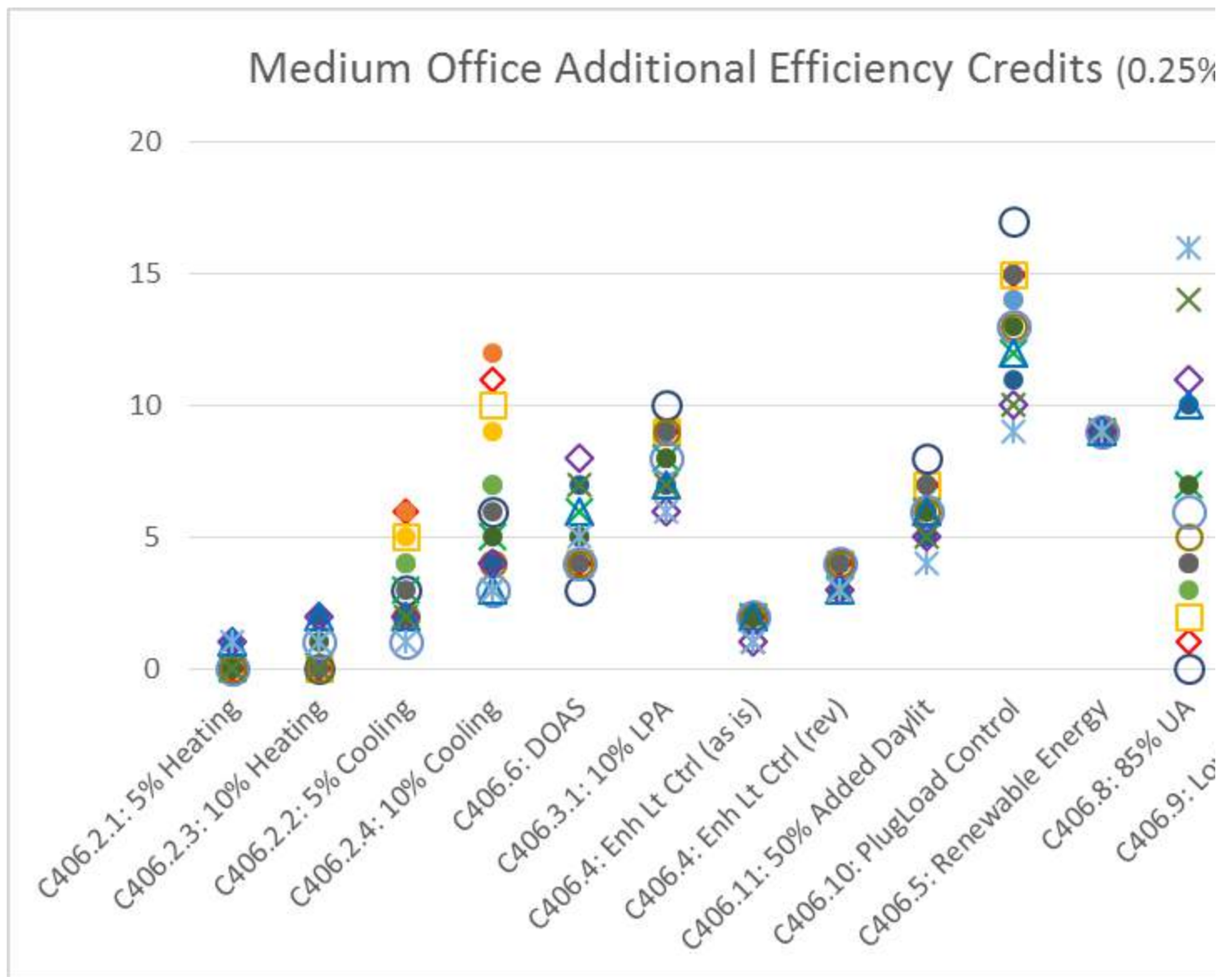


Figure [if supportFields]> SEQ Figure * ARABIC

The points resulting from averaging four typical C406 measures (10% HVAC, 10% LPA, Renewable and 85% UA) are shown as the last item on the right side of Figure 2. These four average around 10 points across climate zones, while lighting power allowance—a popular option selection—averages around 8 points across climate zones. Selecting 10 points or 2.5% savings of building energy cost as the target of a point-based system makes sense as being slightly ahead or roughly equal to the approach followed in the 2018 IECC.

What strategies are considered to minimize compliance burdens?

To achieve savings from a combination of multiple measures under the 2018 IECC, the only recourse is to follow the performance path that requires a building model. Having a simple table of points for measures in different building types and climate zones bypasses the need for full performance modeling, which can be expensive relative to savings for smaller buildings. The end result is a performance-based approach that can be applied with the simplicity of a prescriptive approach.

Are there existing codes and standards that take a similar approach?

The outlined approach is based on the structure currently employed in the IECC for commercial buildings. It just

shifts from a “pick one” approach to one that selects adequate measures from the options to meet a required point level. It is also similar to packages of measures that have been utilized in both residential and commercial energy codes, particularly in the Pacific Northwest. The Washington code has successfully used such a structure to balance energy performance, design flexibility, and evolving technologies.

The existing measures were modified to better fit within the points option and to provide more flexibility.

More efficient HVAC heating performance (C406.2) There has been industry feedback that it is difficult to comply with the 10% increase in efficiency for the More Efficient HVAC Option because both the heating and cooling equipment must comply. The points option allows either heating or cooling or both to comply. This measure would be modified to provide separate credits for the following:

- Medium efficiency HVAC heating performance (C406.2.1) is a 5% improvement in efficiency over the existing minimum requirement.
- Medium efficiency HVAC cooling performance (C406.2.2) is a 5% improvement in efficiency over the existing minimum requirement.
- High Efficiency HVAC heating performance (C406.2.3) is a 10% improvement in efficiency over the existing minimum requirement.
- High Efficiency HVAC cooling performance (C406.2.4) is a 10% improvement in efficiency over the existing minimum requirement

–

Note: If equipment efficiency tables for VRF or other items are added by another proposal, then remove the reference to the ASHRAE 90.1 tables and adjust the table number reference range to include all HVAC equipment tables.

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– **C406.3 Reduced lighting power.** The proposal keeps the 10% reduced lighting power allowance threshold and adds a threshold of 15%. Lighting designers that want to design to lower LPD levels can also use the calculation (Equation 4-12) to achieve more points giving them more flexibility.

– **C406.5 On-site renewable energy.** The onsite renewable energy credit has been modified to allow for additional credit from increased system size over the base level requirement for this credit.

– **C406.7.1 Reduced energy use in service water heating.** The water heating option allows for credit for high efficiency gas and electric water heaters in addition to heat recovery.

Bibliography: Hart R and B Liu. 2015. *Methodology for Evaluating Cost-effectiveness of Commercial Energy Code Changes*. PNNL-23923, Rev1, Pacific Northwest National Laboratory for U.S. Department of Energy; Energy Efficiency & Renewable Energy. <https://www.energycodes.gov/development/commercial/methodology>. Hart R and J Zhang. 2018. *Cost-effectiveness Analysis of Hi-rise Residential Building Air Leakage Testing*. <https://www.energycodes.gov/sites/default/files/documents/TBD.pdf>.

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Cost Impact

Cost Impact: The code change proposal will not increase or decrease the cost of construction. The current proposal does not require more investment, but rather expands existing options permitted under the 2018 IECC. The intention is to assess relative savings equity amongst current options, and identify additional options to increase flexibility and more effectively utilize new technologies and construction practices. There is not expected to be an increased cost, as several of the evaluated options are included in current code. In some cases, costs may be reduced, as the outlined approach provides partial credit for selected items as well as credit for items that may have previously been included in the building design without credit. Costs, and cost effectiveness, are not evaluated for individual measures due to the vast number of potential combinations amongst building types, climates, and selected options. Actual costs will vary based on the items selected by the building designer—architects, engineers, and other involved trades—based on the needs and goals of the individual project.

Proposal # 4960

CE218-19

CE219-19

IECC: C406.1

Proponent: Marilyn Williams, representing National Electrical Manufacturers Association
(mar_williams@nema.org)

2018 International Energy Conservation Code

Revise as follows:

C406.1 Requirements. Buildings shall comply with ~~one~~two or more of the following:

1. More efficient HVAC performance in accordance with Section C406.2.
2. Reduced lighting power in accordance with Section C406.3.
3. Enhanced lighting controls in accordance with Section C406.4.
4. On-site supply of renewable energy in accordance with Section C406.5.
5. Provision of a dedicated outdoor air system for certain HVAC equipment in accordance with Section C406.6.
6. High-efficiency service water heating in accordance with Section C406.7.
7. Enhanced envelope performance in accordance with Section C406.8.
8. Reduced air infiltration in accordance with Section C406.9

Reason: Section C406.1 establishes a set of additional efficiency measure options above base code requirements. The present code requires compliance with only one measure, yet the list of efficiency options has continued to grow without adding any efficiency to buildings. This proposal would modify the requirement so buildings would comply with two packages instead of just one to increase the energy efficiency of buildings.

Cost Impact: The code change proposal will increase the cost of construction
The impact would be the cost of the added measure which increases the energy efficiency of the building.

Proposal # 4441

CE219-19

CE220-19

IECC: C406.1

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:

C406.1 Requirements. Buildings shall comply with ~~one~~two or more of the following:

1. More efficient HVAC performance in accordance with Section C406.2.
2. Reduced lighting power in accordance with Section C406.3.
3. Enhanced lighting controls in accordance with Section C406.4.
4. On-site supply of renewable energy in accordance with Section C406.5.
5. Provision of a dedicated outdoor air system for certain HVAC equipment in accordance with Section C406.6.
6. High-efficiency service water heating in accordance with Section C406.7.
7. Enhanced envelope performance in accordance with Section C406.8.
8. Reduced air infiltration in accordance with Section C406.9

Reason: The purpose of this code change proposal is to improve the efficiency of the prescriptive compliance path by requiring the selection of two additional efficiency package options instead of only one. Section C406 was adopted in the 2012 IECC not only as an immediate efficiency improvement, but also as a means of facilitating code improvements in the future. As new technologies become available, the package options can be updated or the list of options can be expanded (as it was in the 2018 IECC) to provide more flexibility for code users. As additional efficiency is needed, the number of required options can be increased. Several states have adopted a package- or points-based approach similar to Section C406, and as more efficiency is needed, the number of options (or points) has been increased. We note that this proposal deals only with the prescriptive path, and that a separate proposal will address needed efficiency improvements in the performance path.

Cost Impact: The code change proposal will increase the cost of construction. The proposal requires additional efficiency measures to be installed in the building which will increase costs. However, we expect that design professionals and builders will select the package options that are the most cost-effective and the easiest to implement into specific designs.

Proposal # 4202

CE220-19

CE221-19

IECC: C406.2

Proponent: Steven Rosenstock, Edison Electric Institute, representing Edison Electric Institute
(srosenstock@eei.org)

2018 International Energy Conservation Code

Revise as follows:

C406.2 More efficient HVAC equipment performance. Equipment shall exceed the minimum efficiency requirements listed in Tables C403.3.2(1) through C403.3.2(7) by 10 percent, in addition to the requirements of Section C403. Where multiple performance requirements are provided, the equipment shall exceed all requirements by 10 percent. *Variable refrigerant flow systems* shall exceed the energy efficiency provisions of ANSI/ASHRAE/IESNA 90.1 by 10 percent. Equipment-Building designers or owners using equipment not listed in Tables C403.3.2(1) through C403.3.2(7-9) shall be limited to 10 percent of the total building system capacity. provide documentation of equivalent energy efficiency performance to the satisfaction of the code official.

Reason: There are numerous problems with the current language that need to be fixed. This proposal improves the language in this section and provides more high-efficiency options.

1) VRF system limits

Under the current language, high-efficiency VRF systems are allowed to be used, but since they are not listed in Tables C403.2.3(1) through C403.2.3(7), they are limited to 10% of the building system capacity.

2) Cooling Tower limits

Under the current language, cooling towers are shown in Table C403.2.3(8). Since they are not listed in Tables C403.2.3(1) through C403.2.3(7), they are limited to 10% of the building system capacity. So a building could have a 500-ton water chiller system, but would only be allowed to install a 50-ton cooling tower. This is not technically feasible.

3) Computer Room AC limits

Under the current language, computer room AC units are shown in Table C403.2.3(9). Since they are not listed in Tables C403.2.3(1) through C403.2.3(7), they are limited to 10% of the building system capacity. So if a building with a data center has 500 tons of cooling needed, with 250 tons needed for the data center, under the current language, you are only allowed to have 50 tons of computer room AC systems. Again, this is not feasible.

4) Limits on other high-efficiency HVAC equipment that is not listed in tables

Under the current language and tables in the IECC, many types of high-efficiency technologies are limited by the current language. The following is a partial list of technologies that are restricted by the current arbitrary 10% limit:

- Chilled Beam Systems
- Radiant Systems
- DX-DOAS units, without energy recovery
- DX-DOAS units, with energy recovery

- Vapor Compression Based Indoor Pool Dehumidifiers
- Floor-mounted computer room AC units (not listed in current tables)
- Ceiling-mounted computer room AC units (not listed in current tables)
- Combined space heating / water heating systems
- Heat Pump and Heat Reclaim Chiller Packages

Building owners and designers should be allowed to use other high-efficiency equipment to meet the criteria for additional HVAC energy efficiency without having to go to a full performance path option. This proposal allows the use of advanced technologies to improve the efficiency of the HVAC equipment (and the building) with the condition that proof must be provided to show energy savings.

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

As an additional efficiency option allowing more technologies to be used, the impact on construction costs will depend on the technology that is chosen. To be conservative, it is assumed that the newer high-efficiency technologies have higher costs since they may not have achieved economies of scope and/or scale.

Proposal # 4707

CE221-19

CE222-19

IECC: C406.2

Proponent: Steven Rosenstock, Edison Electric Institute, representing Edison Electric Institute
(srosenstock@eei.org)

2018 International Energy Conservation Code

Revise as follows:

C406.2 More efficient HVAC equipment performance. Equipment with a rated heating or cooling capacity of less than 300,000 Btu/hour (87.9 kW) shall exceed the minimum efficiency requirements listed in Tables C403.3.2(1) through C403.3.2(7) by 10 percent, in addition to the requirements of Section C403. Where multiple performance requirements are provided, the equipment shall exceed all requirements by 10 percent. Equipment with a rated heating or cooling capacity of 300,000 Btu/hour (87.9 kW) or greater shall exceed the minimum efficiency requirements listed in Tables C403.3.2(1) through C403.3.2(7) by 5 percent, in addition to the requirements of Section C403. Where multiple performance requirements are provided, the equipment shall exceed all requirements by 5 percent.

Variable refrigerant flow systems shall exceed the energy efficiency provisions of ANSI/ASHRAE/IESNA 90.1 by 10 percent. Equipment not listed in Tables C403.3.2(1) through C403.3.2(7) shall be limited to 10 percent of the total building system capacity.

Reason: New federal energy efficiency standards and new provisions in ASHRAE 90.1 continue to increase the minimum

energy efficiency of many HVAC products. For an increasing number of products, especially in the larger sizes, the difference

in energy efficiency between the required baseline models and the higher efficiency models is less than 10%.

To provide options for buildings with larger equipment, this proposal requires smaller commercial equipment to increase efficiency by 10%, while larger equipment has to increase efficiency by 5%. For both heating and cooling systems, 300,000 Btu/hour (or 25 tons of cooling capacity) is a reasonable "break point" for additional efficiency requirements.

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

For larger buildings with larger HVAC equipment, this proposal makes the requirement more reasonable and achievable. For buildings using smaller HVAC equipment, this proposal will have no impact on the construction costs, as the requirement for smaller equipment is not changed.

Proposal # 4731

CE222-19

CE223-19

IECC: C406.2

Proponent: Charles Foster, Self, representing self (cfoster20187@yahoo.com)

2018 International Energy Conservation Code

Revise as follows:

C406.2 More efficient HVAC equipment performance. Equipment shall exceed the minimum efficiency requirements listed in Tables C403.3.2(1) through C403.3.2(7) by 10 percent, in addition to the requirements of Section C403. Where multiple performance requirements are provided, the equipment shall exceed all requirements by 10 percent. Variable refrigerant flow systems shall exceed the energy efficiency provisions of ANSI/ASHRAE/IESNA 90.1 by 10 percent. ~~Equipment not listed in Tables C403.3.2(1) through C403.3.2(7) shall be limited to 10 percent of the total building system capacity.~~

Reason: Under the current language, high-efficiency VRF systems are allowed to be used, but since they are not listed in Tables C403.2.3(1) through C403.2.3(7), they are limited to 10% of the building system capacity.

2) Cooling Tower limits

Under the current language, cooling towers are shown in Table C403.2.3(8). Since they are not listed in Tables C403.2.3(1) through C403.2.3(7), they are limited to 10% of the building system capacity. So a building could have a 500-ton water chiller system, but would only be allowed to install a 50-ton cooling tower. This is not technically feasible.

3) Computer Room AC limits

Under the current language, computer room AC units are shown in Table C403.2.3(9). Since they are not listed in Tables C403.2.3(1) through C403.2.3(7), they are limited to 10% of the building system capacity. So if a building with a data center has 500 tons of cooling needed, with 250 tons needed for the data center, under the current language, you are only allowed to have 50 tons of computer room AC systems. Again, this is not feasible.

4) Limits on other high-efficiency HVAC equipment that is not listed in tables

Under the current language and tables in the IECC, many types of high-efficiency technologies are limited by the current language. The following is a partial list of technologies that are restricted by the current arbitrary 10% limit:

Chilled Beam Systems

Radiant Systems

DX-DOAS units, without energy recovery

DX-DOAS units, with energy recovery

Vapor Compression Based Indoor Pool Dehumidifiers

Floor-mounted computer room AC units (not listed in current tables)

Ceiling-mounted computer room AC units (not listed in current tables)

Combined space heating / water heating systems

Heat Pump and Heat Reclaim Chiller Packages

Building owners and designers should be allowed to use other high-efficiency equipment to meet the criteria for additional HVAC energy efficiency without having to go to a full performance path option. This proposal allows the use of advanced technologies to improve the efficiency of the HVAC equipment (and the building) with the condition that proof must be provided to show energy savings.

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

This proposal would add flexibility which typically leads to lower costs. On the other hand, it could also lead to higher costs if owners chose to install higher efficiency equipment.

Proposal # 5156

CE223-19

CE224-19

IECC: C406.2, TABLE C406.2 (New)

Proponent: Mark Lessans, Ingersoll Rand, representing Ingersoll Rand (mark.lessans@irco.com)

2018 International Energy Conservation Code

Revise as follows:

C406.2 More efficient HVAC equipment performance. Equipment shall ~~exceed~~ comply with the minimum efficiency requirements listed in Tables C403.3.2(1) through C403.3.2(7) by 10 percent following requirements, as applicable, in addition to the requirements of Section C403. ~~Where multiple performance requirements are provided, the equipment shall exceed all requirements by 10 percent.~~

1. Package unitary air-cooled systems with cooling capacity greater than 65,000 Btu/h shall meet or exceed the applicable efficiency requirements listed in Table C406.2, or shall exceed the mandatory federal minimum efficiency requirements for IEER by not less than 10 percent, whichever is greater.
2. All other electrically operated unitary air conditioners and heat pumps with cooling capacity less than 760,000 Btu/h shall exceed the mandatory federal minimum efficiency requirements by not less than 10 percent.
3. Variable refrigerant flow systems shall exceed the energy efficiency provisions of ANSI/ASHRAE/IESNA 90.1 by not less than 10 percent.
4. All other systems shall exceed the applicable minimum efficiency requirements listed in Tables C403.3.2(1) through C403.3.2(7) by not less than 10 percent. Equipment not listed in Tables C403.3.2(1) through C403.3.2(7) shall be limited to 10 percent of the total building system capacity.

Add new text as follows:

TABLE C406.2
MINIMUM EFFICIENCY REQUIREMENTS: MORE EFFICIENT HVAC EQUIPMENT PERFORMANCE UNITARY AIR-COOLED SYSTEMS

<u>EQUIPMENT TYPE</u>	<u>SIZE CATEGORY</u>	<u>HEATING SECTION TYPE</u>	<u>SUBCATEGORY OR RATING CONDITION</u>	<u>MINIMUM EFFICIENCY</u>	<u>TEST PROCEDURE</u>
<u>Air conditioners, air cooled</u>	<u>≥ 65,000 Btu/h and < 135,000 Btu/h</u>	<u>Electric Resistance (or None)</u>	<u>Single Package</u>	<u>18.0 IEER</u>	<u>AHRI 340/360</u>
		<u>All other</u>	<u>Single Package</u>	<u>17.8 IEER</u>	
	<u>≥ 135,000 Btu/h and < 240,000 Btu/h</u>	<u>Electric Resistance (or None)</u>	<u>Single Package</u>	<u>17.0 IEER</u>	
		<u>All other</u>	<u>Single Package</u>	<u>16.8 IEER</u>	
	<u>≥ 240,000 Btu/h</u>	<u>Electric Resistance (or None)</u>	<u>Single Package</u>	<u>14.5 IEER</u>	
		<u>All other</u>	<u>Single Package</u>	<u>14.3 IEER</u>	
	<u>≥ 65,000 Btu/h and < 135,000 Btu/h</u>	<u>Electric Resistance (or None)</u>	<u>Single Package</u>	<u>16.0 IEER</u>	
		<u>All other</u>	<u>Single Package</u>	<u>15.8 IEER</u>	

<u>Heat pumps, air cooled (cooling mode)</u>	<u>≥ 135,000 Btu/h and < 240,000 Btu/h</u>	<u>Electric Resistance (or None)</u>	<u>Single Package</u>	<u>15.0 IEER</u>	<u>AHRI 340/360</u>
		<u>All other</u>	<u>Single Package</u>	<u>14.8 IEER</u>	
	<u>≥ 240,000 Btu/h</u>	<u>Electric Resistance (or None)</u>	<u>Single Package</u>	<u>14.5 IEER</u>	
		<u>All other</u>	<u>Single Package</u>	<u>14.3 IEER</u>	
<u>Heat pumps, air cooled (heating mode)</u>	<u>≥ 65,000 Btu/h and < 135,000 Btu/h (cooling capacity)</u>	<u>=</u>	<u>47°F db/43°F wb outdoor air</u>	<u>3.5 COP</u>	<u>AHRI 340/360</u>
	<u>≥ 135,000 Btu/h (cooling capacity)</u>	<u>=</u>	<u>47°F db/43°F wb outdoor air</u>	<u>3.6 COP</u>	

Reason: The purpose of this code change proposal is to ensure that next-generation commercial unitary air conditioners and heat pumps - those which are high-efficiency by future standards - are effectively promoted by Section C406.2 of the IECC. In doing so, this proposal will better align the energy code with DOE appliance and equipment standards, above-code programs, and manufacturer plans to improve their product offerings in response to them.

As written, C406.2 requires that all minimum efficiency requirements listed in the equipment efficiency tables of Section C403 be exceeded 10 percent. This requirement is appropriate new buildings which utilize multiple equipment types for space conditioning, as well as for equipment that has multiple performance compliance paths. However, for package air-cooled unitary systems, conventionally referred to as rooftop units (RTUs), there are typically three different efficiency metrics listed in the equipment efficiency tables, all of which must be met. Exceeding these efficiencies proportionally does not make sense given updated standards and the capabilities of RTUs, and creates conflicting as well as commercially unattainable requirements.

This proposal solves this issue for package RTUs by focusing their requirements in C406.2 predominantly on cooling efficiency as defined by IEER, as this equipment operates primarily in cooling mode, even in cold climates. Additionally, IEER is the metric used by DOE for federal appliance standards covering this equipment. This proposal aligns efficiency requirements for commercial unitary air conditioners with those in the Consortium for Energy Efficiency (CEE) Advanced Tier specification, which took effect on January 1, 2019. CEE does not develop an Advanced Tier specification for commercial package heat pumps, so improvements proportionally similar are used in this proposal.

If approved, this proposal would raise IEER for package air-cooled unitary systems by roughly 25-40% above the requirements of Section C403, as well as roughly 10-20% above the efficiencies required by updated DOE appliance standards that take effect in 2023. Additionally, this proposal creates a “backstop” of 10% above federal appliance standards, so that the intent of Section C406.2 is met if DOE standards for this equipment is updated prior to revisions to Table C406.2. All other efficiency metrics governing RTUs will remain in place, as the equipment still must comply with all requirements of Section C403.

This code change is necessary to avoid conflicting requirements between EER and IEER, as well as commercially unattainable requirements for AFUE. Regarding EER (full-load performance) and IEER (blended part- and full-load performance), optimizing for one performance condition will yield sub-optimal performance at

another. While new products may improve both EER and IEER, one can only be improved incrementally at the expense of the other, and therefore requiring both to improve proportionally is not appropriate. Regarding AFUE, the requirements placed on furnaces and gas heating elements by C406.2 requires moving to a condensing technology, which is not commercially available in RTUs outside of highly niche applications. The product availability gap is related to condensate disposal; in rooftop applications there is no industry-accepted practice to dispose of condensing furnace condensate discharge, and inappropriate applications will lead to roof damage.

This code change proposal makes significant improvements to package air-cooled unitary system cooling efficiencies, and removes conflicting requirements that would prevent premium efficiency, next-generation equipment from being used in new construction. It maintains the intent of Section C406, while also keeping C406.2 relevant given changes to appliance standards and industry innovation since its original inclusion in the 2012 IECC.

Cost Impact: The code change proposal will not increase or decrease the cost of construction
This is an editorial change only.

Proposal # 4500

CE224-19

CE225-19

IECC: C406.2, TABLE C406.2 (New)

Proponent: Mark Lessans, Ingersoll Rand, representing Ingersoll Rand (mark.lessans@irco.com)

2018 International Energy Conservation Code

Revise as follows:

C406.2 More efficient HVAC equipment performance. Equipment shall exceed the minimum efficiency requirements listed in Tables C403.3.2(1) through C403.3.2(7) by 10 percent, in addition to the requirements of Section C403. Where multiple performance requirements are provided, the equipment shall exceed all requirements by 10 percent. *Variable refrigerant flow systems* shall exceed the energy efficiency provisions of ANSI/ASHRAE/IESNA 90.1 by 10 percent. Equipment not listed in Tables C403.3.2(1) through C403.3.2(7) shall be limited to 10 percent of the total building system capacity.

Exception: Electrically operated unitary and applied heat pumps that do not utilize electric resistance heating elements and utilize a gas-fired furnace for supplemental heating shall comply with the minimum efficiency requirements in Table C406.2, in addition to the requirements of Section C403.

Add new text as follows:

TABLE C406.2

MINIMUM EFFICIENCY REQUIREMENTS: MORE EFFICIENT HVAC PERFORMANCEDUAL FUEL UNITARY AND APPLIED HEAT PUMPS

<u>EQUIPMENT TYPE</u>	<u>SIZE CATEGORY</u>	<u>SUBCATEGORY OR RATING CONDITION</u>	<u>MINIMUM EFFICIENCY</u>	<u>TEST PROCEDURE</u>
<u>Air cooled</u> <u>(cooling mode)</u>	<u>< 65,000 Btu/h</u>	<u>Single Package</u>	<u>15.6 SEER</u> <u>12.8 EER</u>	<u>AHRI</u> <u>340/360</u>
	<u>≥ 65,000 Btu/h</u>	<u>Single Package</u>	<u>11.5 EER</u> <u>14.1 IEER</u>	
<u>Air cooled</u> <u>(heating mode, heat pump</u> <u>operation only)</u>	<u>< 65,000 Btu/h</u> <u>(cooling capacity)</u>	<u>47°F db/43°F wb outdoor</u> <u>air</u>	<u>8.8 HSPF</u>	<u>AHRI</u> <u>340/360</u>
	<u>≥ 65,000 Btu/h</u> <u>(cooling capacity)</u>	<u>47°F db/43°F wb outdoor</u> <u>air</u>	<u>3.4 COP</u>	

Reason: For mechanical equipment to comply with Section C406.2 of the 2018 IECC, it must exceed by 10 percent the efficiencies listed in Tables C403.3.2(1) through C403.3.2(7), which require that gas-fired commercial warm air furnaces have an efficiency rating of at least 88 AFUE. However, in order for a furnace to meet this efficiency level, it must utilize a condensing technology, and in rooftop applications it is difficult to safely and effectively dispose of furnace condensate. By contrast, residential condensing furnaces typically dispose of condensate through a side wall of a home. As a result, condensing furnaces are niche, non-commercialized products in commercial applications, which severely limits the ability to use a furnace when complying with Section C406.2. The only realistic option for small commercial buildings with rooftop units is to use heat pumps which meet the efficiency requirements of Section C406.2, but even at these improved performance ratings, it does not make sense to forego the use of warm air furnaces in cold climates. The proposed code change will remove this barrier for dual fuel commercial rooftop units – packaged units which contain both a heat pump and a furnace for heating. In these systems, the heat pump is the primary source of heating, but when the outdoor ambient temperature is too low for the heat pump to operate

effectively, the compressor disengages, and rather than relying on an electric resistance source, a natural gas furnace provides supplementary heating. This approach allows the rooftop unit to utilize a heat pump when it is efficient to do so, such as during shoulder seasons and mild winter days, and switch to a natural gas furnace at very low outdoor temperatures when the heat pump cannot perform efficiently, if at all. The result is a mechanical system that can be optimized for energy efficiency and lower operating costs, as well as for effective electric demand management without loss of heating utility.

This proposed code change is necessary to fully enable buildings in cold climates to benefit from the optimized utilization of both a heat pump and furnace to provide heating. Dual fuel commercial rooftop units are available from multiple equipment manufacturers in 3-10 ton (36,000-120,000 Btu/h) capacities, and much of the small commercial market segment served by these units uses the prescriptive path to comply with the energy code. This proposed code change increases the heat pump performance requirements beyond 10 percent, as would otherwise be required by C406.2, to make up for the use of a standard efficiency furnace to ensure the intent of this provision is met. As a result, the prescriptive path in the IECC will enable improved HVAC performance while maintaining comfort and cost-effectiveness – the intent of Section C406.2.

Because this change is part of an optional path, designers will be able to select a system that is optimized for a particular building design in order to maximize the energy-savings benefit. The requirement for additional efficiency measures is intended to provide flexibility in design with optimized costs; including the dual fuel heat pump option brings another technology to the table. It does not replace other options, it simply provides greater opportunity for efficient HVAC system selections – and energy efficiency.

The only reasonable alternative to this code change proposal is to maintain the status quo requirements in Section C406.2 of the IECC, which does little to recognize the energy efficiency benefit of dual fuel rooftop units. As written, C406.2 directs the building designer to select either a high efficiency heat pump or high efficiency furnace, both of which have their own technical limitations:

- Heat pump coefficient of performance (COP) declines as outdoor ambient temperatures get colder. At very low ambient temperatures, the heat pump compressor will completely disengage, and instead rely on a resistance heating element, which results in a $COP < 1.0$.
- Furnaces complying with C406.2 must have an annual fuel utilization efficiency (AFUE) ≥ 88 , which requires moving to a condensing technology not commercially available in rooftop units.

Dual fuel RTUs solve these limitations by operating in heat pump heating mode when it is efficient to do so, and furnace heating mode when the heat pump cannot run efficiently. In many buildings, this will yield improved source efficiency, significantly lower energy costs, and lower combined emissions when compared to any other practical alternative.

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

The proposed code change will decrease construction costs by providing additional options for equipment to comply with Section C406.2 and allowing the designer to select the optimal solution. It will also decrease utility costs for building owners and occupants by utilizing the most efficient heating source for a given outdoor ambient temperature, and has the potential to decrease utility costs further by enabling more effective demand response during peak electricity periods.

CE226-19

IECC: SECTION C406, C406.1, TABLE C406.1(1) (New), TABLE C406.1(2) (New), TABLE C406.1(3) (New), TABLE C406.1(4) (New), TABLE C406.1(5) (New), C406.1.1, C406.2, C406.2.1 (New), C406.2.2 (New), C406.2.3 (New), C406.2.4 (New), C406.3, C406.3.3 (New), C406.5 (New), C406.5, C406.5.2 (New), C406.7, C406.7.1, C406.7.3 (New), C406.7.4 (New)

Proponent: Louis Starr (lstarr@neea.org)

2018 International Energy Conservation Code

SECTION C406 ADDITIONAL EFFICIENCY PACKAGE OPTIONS REQUIREMENTS

C406.1 Requirements- Additional efficiency requirements. Buildings shall comply ~~New buildings shall achieve a total of 10 credits from Tables C406.1(1) through C406.1(5) where the table is selected based on the use group of the building. Where a building contains multiple use groups, credits from each use group shall be weighted by floor area of each group to determine the weighted average building credit. Credits may also be as calculated in accordance the relevant subsection of C406. Credits from the tables or calculation shall be achieved where a building complies with one or more of the following:~~

1. More efficient HVAC performance in accordance with Section C406.2.
2. Reduced lighting power in accordance with Section C406.3.
3. Enhanced lighting controls in accordance with Section C406.4.
4. On-site supply of renewable energy in accordance with Section C406.5.
5. Provision of a dedicated outdoor air system for certain HVAC equipment in accordance with Section C406.6.
6. High-efficiency service water heating in accordance with Section C406.7.
7. Enhanced envelope performance in accordance with Section C406.8.
8. Reduced air infiltration in accordance with Section C406.9

Add new text as follows:

**TABLE C406.1(1)
ADDITIONAL ENERGY EFFICIENCY CREDITS FOR GROUP B OCCUPANCIES**

Sub-section / Climate Zone:	1A	1B	2A	2B	3A	3B	3C	4A	4B	4C	5A	5B	5C	6A	6B	7	8
C406.2.1: 5% Heating Eff Imprv.	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1	NA	NA	1	1	NA	1
C406.2.2: 5% Cooling Eff Imprv.	6	6	5	5	4	4	3	3	3	2	2	2	1	2	2	2	1
C406.2.3: 10 % Heating Eff Imprv.	NA	NA	NA	NA	NA	NA	NA	1	NA	NA	2	1	1	2	2	NA	1
C406.2.4: 10 % Cooling Eff Imprv.	11	12	10	9	7	7	6	5	6	4	4	5	3	4	3	3	3
C406.3.1: Reduce Light Power 10%	9	8	9	9	9	9	10	8	9	9	7	8	8	6	7	7	6
C406.3.3: Lamp Efficacy	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
C406.4: Enh. Digital Light Ctrl	2	2	2	2	2	2	2	2	2	2	2	2	2	1	2	1	1
C406.5.1: On-site Renewable Egy.	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9
C406.6 : Dedicated OA Sys (DOAS)	4	4	4	4	4	3	2	5	3	2	5	3	2	7	4	5	3
C406.7.2: Recovered/Renew SWH	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
C406.7.3: Eff fossil fuel SWH	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

C406.7.4: Heat Pump SWH	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
C406.8: Enhanced Envelope Perf	<u>1</u>	<u>4</u>	<u>2</u>	<u>4</u>	<u>4</u>	<u>3</u>	NA	<u>7</u>	<u>4</u>	<u>5</u>	<u>10</u>	<u>7</u>	<u>6</u>	<u>11</u>	<u>10</u>	<u>14</u>	<u>16</u>
C406.9: Reduced Air Infiltration	<u>2</u>	<u>1</u>	<u>1</u>	<u>2</u>	<u>4</u>	<u>1</u>	NA	<u>8</u>	<u>2</u>	<u>3</u>	<u>11</u>	<u>4</u>	<u>1</u>	<u>15</u>	<u>8</u>	<u>11</u>	<u>6</u>

TABLE C406.1(2)
ADDITIONAL ENERGY EFFICIENCY CREDITS FOR GROUP R AND I OCCUPANCIES

Sub-section / Climate Zone:	1A	1B	2A	2B	3A	3B	3C	4A	4B	4C	5A	5B	5C	6 A	6 B	7	8
C406 .2.1: 5% Heating Eff Imprv.	NA	NA	NA	NA	<u>1</u>	NA	NA	<u>1</u>	NA	<u>1</u>	<u>1</u>	<u>1</u>	<u>1</u>	<u>2</u>	<u>1</u>	<u>2</u>	<u>2</u>
C406 .2.2: 5% Cooling Eff Imprv.	<u>3</u>	<u>3</u>	<u>2</u>	<u>2</u>	<u>1</u>	<u>1</u>	<u>1</u>	<u>1</u>	<u>1</u>	NA	<u>1</u>	<u>1</u>	NA	<u>1</u>	<u>1</u>	<u>1</u>	NA
C406 .2.3: 10 % Heating Eff Imprv.	NA	NA	NA	NA	<u>1</u>	NA	NA	<u>1</u>	<u>1</u>	<u>1</u>	<u>2</u>	<u>2</u>	<u>1</u>	<u>3</u>	<u>2</u>	<u>3</u>	<u>4</u>
C406 .2.4: 10 % Cooling Eff Imprv.	<u>5</u>	<u>5</u>	<u>4</u>	<u>3</u>	<u>2</u>	<u>3</u>	<u>1</u>	<u>2</u>	<u>2</u>	<u>1</u>	<u>1</u>	<u>1</u>	<u>1</u>	<u>1</u>	<u>1</u>	<u>1</u>	<u>1</u>
C406 .3.1: Reduce Light Power 10%	<u>2</u>	<u>2</u>	<u>2</u>	<u>2</u>	<u>2</u>	<u>2</u>	<u>3</u>	<u>2</u>	<u>2</u>	<u>2</u>	<u>2</u>	<u>2</u>	<u>2</u>	<u>2</u>	<u>2</u>	<u>2</u>	<u>2</u>
C406 .3.3: Lamp Efficacy	<u>2</u>	<u>2</u>	<u>2</u>	<u>2</u>	<u>1</u>	<u>2</u>	<u>2</u>	<u>1</u>	<u>1</u>	<u>1</u>	<u>1</u>	<u>1</u>	<u>1</u>	<u>1</u>	<u>1</u>	<u>1</u>	<u>1</u>
C406 .4: Enh. Digital Light Ctrl	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
C406 .5.1: On-site Renewable Egy.	<u>8</u>	<u>8</u>	<u>8</u>	<u>8</u>	<u>7</u>	<u>8</u>	<u>8</u>	<u>7</u>	<u>7</u>	<u>7</u>	<u>7</u>	<u>7</u>	<u>7</u>	<u>7</u>	<u>7</u>	<u>7</u>	<u>7</u>
C406 .6 : Dedicated OA Sys (DOAS)	<u>3</u>	<u>4</u>	<u>3</u>	<u>3</u>	<u>4</u>	<u>2</u>	NA	<u>6</u>	<u>3</u>	<u>4</u>	<u>8</u>	<u>5</u>	<u>5</u>	<u>10</u>	<u>7</u>	<u>11</u>	<u>12</u>
C406 .7.2: Recovered/Renew SWH	<u>10</u>	<u>9</u>	<u>11</u>	<u>10</u>	<u>13</u>	<u>12</u>	<u>15</u>	<u>14</u>	<u>14</u>	<u>15</u>	<u>14</u>	<u>14</u>	<u>16</u>	<u>14</u>	<u>15</u>	<u>15</u>	<u>15</u>
C406 .7.3: Eff fossil fuel SWH	<u>5</u>	<u>5</u>	<u>6</u>	<u>6</u>	<u>8</u>	<u>7</u>	<u>8</u>	<u>8</u>	<u>8</u>	<u>9</u>	<u>9</u>	<u>9</u>	<u>10</u>	<u>10</u>	<u>9</u>	<u>10</u>	<u>11</u>
C406 .7.4: Heat Pump SWH	<u>6</u>	<u>5</u>	<u>5</u>	<u>5</u>	<u>5</u>	<u>5</u>	<u>5</u>	<u>5</u>	<u>5</u>	<u>5</u>	<u>5</u>	<u>5</u>	<u>5</u>	<u>5</u>	<u>5</u>	<u>5</u>	<u>5</u>
C406 .8: Enhanced Envelope Perf	<u>3</u>	<u>6</u>	<u>3</u>	<u>5</u>	<u>4</u>	<u>4</u>	<u>1</u>	<u>4</u>	<u>3</u>	<u>3</u>	<u>4</u>	<u>5</u>	<u>3</u>	<u>5</u>	<u>4</u>	<u>6</u>	<u>6</u>
C406 .9: Reduced Air Infiltration	<u>6</u>	<u>5</u>	<u>3</u>	<u>11</u>	<u>6</u>	<u>4</u>	NA	<u>7</u>	<u>3</u>	<u>3</u>	<u>9</u>	<u>5</u>	<u>1</u>	<u>13</u>	<u>6</u>	<u>8</u>	<u>3</u>

TABLE C406.1(3)
ADDITIONAL ENERGY EFFICIENCY CREDITS FOR GROUP E OCCUPANCIES

Sub-section / Climate Zone:	1A	1B	2A	2B	3A	3B	3C	4A	4B	4C	5A	5B	5C	6 A	6 B	7	8
C406 .2.1: 5% Heating Eff Imprv.	NA	NA	NA	NA	<u>1</u>	<u>1</u>	<u>1</u>	<u>1</u>	<u>1</u>	<u>2</u>	<u>1</u>	<u>2</u>	<u>1</u>	<u>2</u>	<u>2</u>	<u>3</u>	<u>4</u>
C406 .2.2: 5% Cooling Eff Imprv.	<u>4</u>	<u>4</u>	<u>3</u>	<u>3</u>	<u>2</u>	<u>2</u>	<u>2</u>	<u>2</u>	<u>1</u>	<u>1</u>	<u>1</u>	<u>1</u>	NA	<u>1</u>	<u>1</u>	<u>1</u>	NA
C406 .2.3: 10 % Heating Eff Imprv.	NA	NA	NA	<u>1</u>	<u>1</u>	<u>1</u>	<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>	<u>3</u>	<u>4</u>	<u>3</u>	<u>4</u>	<u>3</u>	<u>5</u>	<u>7</u>
C406 .2.4: 10 % Cooling Eff Imprv.	<u>7</u>	<u>8</u>	<u>7</u>	<u>6</u>	<u>5</u>	<u>4</u>	<u>3</u>	<u>4</u>	<u>3</u>	<u>1</u>	<u>2</u>	<u>2</u>	<u>1</u>	<u>2</u>	<u>2</u>	<u>2</u>	<u>1</u>
C406 .3.1: Reduce Light Power 10%	<u>8</u>	<u>8</u>	<u>8</u>	<u>9</u>	<u>8</u>	<u>9</u>	<u>9</u>	<u>8</u>	<u>9</u>	<u>9</u>	<u>8</u>	<u>9</u>	<u>8</u>	<u>7</u>	<u>8</u>	<u>7</u>	<u>7</u>
C406 .3.3: Lamp Efficacy	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
C406 .4: Enh. Digital Light Ctrl	<u>2</u>	<u>2</u>	<u>2</u>	<u>2</u>	<u>2</u>	<u>2</u>	<u>2</u>	<u>2</u>	<u>2</u>	<u>2</u>	<u>2</u>	<u>3</u>	<u>2</u>	<u>2</u>	<u>2</u>	<u>2</u>	<u>1</u>
C406 .5.1: On-site Renewable Egy.	<u>6</u>	<u>6</u>	<u>6</u>	<u>6</u>	<u>6</u>	<u>6</u>	<u>6</u>	<u>6</u>	<u>6</u>	<u>6</u>	<u>6</u>	<u>6</u>	<u>6</u>	<u>6</u>	<u>6</u>	<u>5</u>	<u>5</u>
C406 .6 : Dedicated OA Sys (DOAS)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
C406 .7.2: Recovered/Renew SWH ^a	<u>1</u>	<u>1</u>	<u>1</u>	<u>1</u>	<u>1</u>	<u>1</u>	<u>1</u>	<u>1</u>	<u>1</u>	<u>1</u>	<u>1</u>	<u>1</u>	<u>1</u>	<u>1</u>	<u>1</u>	<u>1</u>	<u>1</u>
C406 .7.3: Eff fossil fuel SWH ^a	NA	<u>1</u>	<u>1</u>	<u>1</u>	<u>1</u>	<u>1</u>	<u>1</u>	<u>2</u>	<u>2</u>	<u>3</u>	<u>2</u>	<u>3</u>	<u>2</u>	<u>3</u>	<u>3</u>	<u>3</u>	<u>5</u>
C406 .7.4: Heat Pump SWH ^a	NA	NA	NA	NA	NA	NA	NA	<u>1</u>	NA	NA	<u>1</u>	<u>1</u>	NA	<u>1</u>	<u>1</u>	<u>1</u>	<u>1</u>
C406 .8: Enhanced Envelope Perf	<u>3</u>	<u>7</u>	<u>3</u>	<u>4</u>	<u>2</u>	<u>4</u>	<u>1</u>	<u>1</u>	<u>3</u>	<u>1</u>	<u>2</u>	<u>3</u>	NA	<u>4</u>	<u>3</u>	<u>6</u>	<u>9</u>
C406 .9: Reduced Air Infiltration	<u>1</u>	<u>1</u>	<u>1</u>	<u>2</u>	NA	NA	NA	NA	NA	NA	<u>1</u>	NA	NA	<u>4</u>	<u>1</u>	<u>4</u>	<u>3</u>

a. For schools with full service kitchens or showers

TABLE C406.1(4)
ADDITIONAL ENERGY EFFICIENCY CREDITS FOR GROUP M OCCUPANCIES

Sub-section / Climate Zone:	1A	1B	2A	2B	3A	3B	3C	4A	4B	4C	5A	5B	5C	6 A	6 B	7	8
C406 .2.1: 5% Heating Eff Imprv.	NA	NA	NA	NA	1	1	NA	1	1	2	2	2	2	3	2	3	4
C406 .2.2: 5% Cooling Eff Imprv.	5	6	4	4	3	3	1	2	2	1	1	2	NA	1	1	1	NA
C406 .2.3: 10 % Heating Eff Imprv.	NA	NA	NA	1	1	1	1	2	2	4	3	4	5	5	3	6	8
C406 .2.4: 10 % Cooling Eff Imprv.	9	12	9	8	6	6	3	4	4	1	2	3	NA	2	2	2	1
C406 .3.1: Reduce Light Power 10%	13	13	15	14	16	14	17	15	15	14	12	14	14	16	16	14	12
C406 .3.3: Lamp Efficacy	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
C406 .4: Enh. Digital Light Ctrl	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
C406 .5.1: On-site Renewable Egy.	8	8	8	8	8	8	8	8	8	7	7	7	7	7	7	7	6
C406 .6 : Dedicated OA Sys (DOAS)	3	4	3	3	3	3	1	3	2	2	2	3	2	4	3	4	4
C406 .7.2: Recovered/Renew SWH	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
C406 .7.3: Eff fossil fuel SWH	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
C406 .7.4: Heat Pump SWH	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
C406 .8: Enhanced Envelope Perf	4	6	3	4	3	3	1	6	4	4	4	5	4	6	5	8	9
C406 .9: Reduced Air Infiltration	1	1	1	2	1	1	NA	3	1	1	3	2	1	7	3	6	3

TABLE C406.1(5)
ADDITIONAL ENERGY EFFICIENCY CREDITS FOR OTHER OCCUPANCIES

Sub-section / Climate Zone:	1A	1B	2A	2B	3A	3B	3C	4A	4B	4C	5A	5B	5C	6 A	6 B	7	8
C406 .2.1: 5% Heating Eff Imprv.	NA	NA	NA	NA	1	1	1	1	1	2	1	2	1	2	2	3	3
C406 .2.2: 5% Cooling Eff Imprv.	5	5	4	4	3	3	2	2	2	1	1	2	1	1	1	1	1
C406 .2.3: 10 % Heating Eff Imprv.	NA	NA	NA	1	1	1	1	2	2	3	3	3	3	4	3	5	5
C406 .2.4: 10 % Cooling Eff Imprv.	8	9	8	7	5	5	3	4	4	2	2	3	2	2	2	2	2
C406 .3.1: Reduce Light Power 10%	8	8	9	9	9	9	10	8	9	9	7	8	8	8	8	8	7
C406 .3.3: Lamp Efficacy	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
C406 .4: Enh. Digital Light Ctrl	2	2	2	2	2	2	2	2	2	2	2	3	2	2	2	2	1
C406 .5.1: On-site Renewable Egy.	8	8	8	8	8	8	8	8	8	7	7	7	7	7	7	7	7
C406 .6 : Dedicated OA Sys (DOAS)	3	4	3	3	4	3	2	5	3	3	5	4	3	7	5	7	6
C406 .7.2: Recovered/Renew SWH ^b	10	9	11	10	13	12	15	14	14	15	14	14	16	14	15	15	15
C406 .7.3: Eff fossil fuel SWH ^b	5	5	6	6	8	7	8	8	8	9	9	9	10	10	9	10	11
C406 .7.4: Heat Pump SWH ^b	6	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
C406 .8: Enhanced Envelope Perf	3	6	3	4	3	4	1	5	4	3	5	5	4	7	6	9	10
C406 .9: Reduced Air Infiltration	3	2	2	4	4	2	NA	6	2	2	6	4	1	10	5	7	4

a. Other occupancy groups include all Groups except for Groups B, R, I, E, and M.

b. For occupancy groups listed in C406 .7.1.

C406.1.1 Tenant spaces. Tenant spaces shall comply with sufficient options form Tables C406 .1(1) through C406 .1(5) to achieve a minimum number of 5 credits, where credits are selected from Section C406.2, C406.3, C406.4, C406.6 or C406.7. Alternatively Where the entire building complies using credits from Section C406 .5, C406 .8 or C406 .9, tenant spaces within the building shall be deemed to comply with Section C406.5 where the entire building is in compliance- this section

Exception: Previously occupied tenant spaces that comply with this code in accordance with Section C501.

C406.2 More efficient HVAC equipment performance. Equipment shall exceed the minimum efficiency requirements listed in Tables C403.3.2(1) through C403.3.2(7) ~~by 10 percent, in addition to the requirements of Section C403. Where multiple performance requirements are provided, the equipment shall exceed all requirements by 10 percent.~~ 9) and Variable refrigerant flow systems shall exceed listed in the energy efficiency provisions of ANSI/ASHRAE/IESNA 90.1 by 10 percent, in accordance with Sections C406 .2.1, C406 .2.2, C406 .2.3 or C406 .2.4. Equipment shall also meet applicable requirements of Section C403. Energy efficiency credits for heating shall be selected from C406 .2.1 or C406 .2.3 and energy efficiency credits for cooling shall be selected from C406 .2.2 or C406 .2.4. Selected credits shall include a heating or cooling energy efficiency credit or both. Equipment not listed in Tables C403.3.2(1) through C403.3.2(7_9) shall be limited to 10 percent of the total building system capacity- capacity for heating equipment where selecting C406 .2.1 or C406 .2.3 and cooling equipment where selecting C406 .2.2 or C406 .2.4.

Add new text as follows:

C406.2.1 Five percent heating efficiency improvement Equipment shall exceed the minimum heating efficiency requirements by 5 percent.

C406.2.2 Five percent cooling efficiency improvement Equipment shall exceed the minimum cooling and heat rejection efficiency requirements by 5 percent. Where multiple cooling performance requirements are provided, the equipment shall exceed the annual energy requirement, including IEER, SEER, and IPLV.

C406.2.3 Ten percent heating efficiency improvement Equipment shall exceed the minimum heating efficiency requirements by 10 percent.

C406.2.4 Ten percent cooling efficiency improvement Equipment shall exceed the minimum cooling and heat rejection efficiency requirements by 10 percent. Where multiple cooling performance requirements are provided, the equipment shall exceed the annual energy requirement, including IEER, SEER, and IPLV.

Revise as follows:

C406.3 Reduced lighting power. The total connected interior lighting power calculated in accordance with Section C405.3.1 shall be less than 90 percent of the total lighting power allowance calculated in accordance with Section C405.3.2. Buildings shall comply with Section C406.3.1 or C406.3.2 and dwelling units and sleeping units within the building shall comply with C406.3.3.

C406.3 C406.3.1 Reduced lighting power- power by more than 10 percent. The total connected interior lighting power calculated in accordance with Section C405.3.1 shall be less than 90 percent of the total lighting power allowance calculated in accordance with Section C405.3.2.

Add new text as follows:

C406.2.3 Reduced lighting power by more than 15 percent. Where the total connected interior lighting power calculated in accordance with Section C405.3.1 is less than 85 percent of the total lighting power allowance calculated in accordance with Section C405.3.2, additional energy efficiency credits shall be determined based on Equation 4-12, rounded to the nearest whole number.

$AEEC_{LPA} = AEEC_{10} \times 10 \times (LPA - LPD) / LPA$ (Equation 4-12)

Where:

$AEEC_{LPA} = C406.3.2$ additional energy efficiency credits

LPD = total connected interior lighting power calculated in accordance with Section C405.3.1

LPA = total lighting power allowance calculated in accordance with Section C405.3.2

$AEEC_{10} = C406.3.1$ credits from Tables C406.1(1) through C406.1(5)

C406.3.3 Lamp efficacy Not less than 95 percent of the interior lighting power (watts) from lamps in permanently installed light fixtures in dwelling units and sleeping units shall be provided by lamps with a minimum efficacy of 65 lumens per watt.

C406.5 On-site renewable energy. Buildings shall comply with Section C406.5.1 or C406.5.2

C406.5 C406.5.1 On-site renewable energy- Basic Renewable Credits The total minimum ratings of on-site renewable energy systems not including systems used for credits under Section C406.7.2 shall be one of the following:

1. Not less than ~~1.71~~ 0.86 Btu/h per square foot (~~5.4~~ 2.7 W/m²) or ~~0.50~~ 0.25 watts per square foot (~~5.4~~ 2.7 W/m²) of conditioned floor area.
2. Not less than ~~3~~ 2 percent of the energy used within the building for building mechanical and service water heating equipment and lighting regulated in Chapter 4.

Add new text as follows:

C406.5.2 Enhanced Renewable Credit Where the total minimum ratings of on-site renewable energy systems exceeds the rating in C406.5.1(1), additional energy efficiency credits shall be determined based on Equation 4-13, rounded to the nearest whole number.

$AEEC_{RRA} = AEEC_{2.5} \times RR_a / RR_1$ (Equation 4-13)

Where:

$AEEC_{RRA} = C406.5.2$ additional energy efficiency credits

RR_a = actual total minimum ratings of *on-site renewable energy* systems (in Btu/h, watts per square foot or W/m²).

RR_1 = minimum ratings of *on-site renewable energy* systems required by C406.5.1(1) (in Btu/h, watts per square foot or W/m²).

$AEEC_{2.5} = C406.5.1$ credits from Tables C406.1(1) through C406.1(5)

C406.7 Reduced energy use in service water heating. Buildings shall comply with Sections C406.7.1 and either C406.7.2, C406.7.3 or C406.7.4. be of the following types to use this compliance method:

1. ~~Group R-1: Boarding houses, hotels or motels.~~
2. ~~Group I-2: Hospitals, psychiatric hospitals and nursing homes.~~
3. ~~Group A-2: Restaurants and banquet halls or buildings containing food preparation areas.~~
4. ~~Group F: Laundries.~~
5. ~~Group R-2.~~

6. ~~Group A-3: Health clubs and spas.~~
7. ~~Buildings showing a service hot water load of 10 percent or more of total building energy loads, as shown with an energy analysis as described in Section C407.~~

~~C406.7 C406.7.1 Reduced energy use in service water heating. Building Type~~ ~~Buildings shall be To qualify for this credit, the building shall contain one be of the following use groups and the additional energy efficiency credit shall be prorated by conditioned floor area of the portion of the building comprised of the following types to use this compliance method groups:~~

1. ~~Group R-1: Boarding houses, hotels or motels.~~
2. ~~Group I-2: Hospitals, psychiatric hospitals and nursing homes.~~
3. ~~Group A-2: Restaurants and banquet halls or buildings containing food preparation areas.~~
4. ~~Group F: Laundries.~~
5. ~~Group R-2.~~
6. ~~Group A-3: Health clubs and spas.~~
7. Group E: Schools with full-service kitchens or locker rooms with showers
8. ~~Buildings showing a service hot water load of 10 percent or more of total building energy loads, as shown with an energy analysis as described in Section C407.~~

~~C406.7.1 C406.7.2 Load fraction. Recovered or renewable water heating~~ ~~The building service water-heating system shall have one or more of the following that are sized to provide not less than 60-30 percent of the building's annual hot water requirements, or sized to provide 100-70 percent of the building's annual hot water requirements if the building shall otherwise is required to comply with Section C403.9.5:~~

1. ~~Waste heat recovery from service hot water, heat-recovery chillers, building equipment, or process equipment.~~
2. ~~On-site renewable energy water-heating systems.~~

Add new text as follows:

C406.7.3 Efficient fossil fuel water heater The combined input-capacity-weighted-average equipment rating of all fossil fuel water heating equipment in the building shall be not less than 95% Et or 0.95 EF. This option shall receive only half the listed credits for buildings required to comply with C404.2.1.

C406.7.4 Heat pump water heater Where electric resistance water heaters are allowed, all service hot water system heating requirements shall be met using heat pump technology with a combined input-capacity-weighted-average EF of 3.0. Air-source heat pump water heaters shall not draw conditioned air from within the building, except exhaust air that would otherwise be exhausted to the exterior.

Reason: C406 Credits for Dwelling Lighting Efficacy

This proposal builds on top of a proposal that assigns energy efficiency credits to each option in Section C406 (CE218-19). For clarity, that entire base proposal is included here with additional provisions and table row additions that provide additional energy efficiency credits when:

- The lighting power density is reduced by more than 15% below the required lighting power allowance. For this option the 10% reduction credits in Section C406.3.1 are multiplied by the ratio of actual lighting power density reduction to lighting power allowance
- The efficacy of lamps installed in sleeping and dwelling units is higher than required in the residential section of the code and appropriate credits for that improvement are added as new lines in the credit tables.

The provision expands the available credits for more than 10% lighting power reduction where the lighting

power density is reduced by more than 15%.

Currently, a 10% lighting reduction in lighting power allowance is required for this extra efficiency option; however dwelling units and sleeping units can follow the residential lighting efficacy requirements. As a result, the applicability of option C406.3 is unclear for multi-family buildings. This measure would make clear the 10% lighting reduction applies to areas in a multi-family building that are not dwelling units and sleeping units and would apply a higher efficacy rating in the dwelling and sleeping units than is required in the residential lighting requirements.

To achieve this extra efficiency credit, this measure would increase the efficacy requirement for lamps in permanently installed fixtures and make them more in line with lamps available today.

This measure provides more clarity for multi-family buildings for the extra efficiency credit. Lamps meeting the higher efficacy requirement are readily available and appropriate for an optional credit.

Bibliography:

Hart, R., R. Nambiar, M. Tyler, M., Y. Xie, and J. Zhang. "Relative Credits for Extra Efficiency Measures: Technical Brief." Pacific Northwest National Laboratory (PNNL), Richland, WA (US), January 2019.

https://www.pnnl.gov/main/publications/external/technical_reports/PNNL-28370Rev.1.pdf.

www.1000bulbs.com for lamp prices

Cost Impact: The code change proposal will not increase or decrease the cost of construction. To achieve the lighting credit in multi-family buildings, this proposal will require higher efficacy lamps in dwelling units and sleeping units. However, these lamps are readily available in the market place, and checking internet sources has found them to actually be less costly than the slightly lower efficacy alternative required under the residential code. LED lamps were found to be about 85% the cost of similar output compact fluorescent lamps. If compared to incandescent lamps, there may be a cost increase, but the life of either the CFL or LED lamps is 10 or 15 times as long, resulting in a much lower cost per year of service.

Further, the current proposal does not require more investment, but rather expands existing options permitted under the 2018 IECC. In fact, credit is now given to lighting reductions greater than 10%. The intention is to assess relative savings equity amongst current options, and identify additional options to increase flexibility and more effectively utilize new technologies and construction practices.

There is not expected to be an increased cost, as several of the evaluated options are included in current code. In some cases, costs may be reduced, as the outlined approach provides partial credit for selected items as well as credit for items that may have previously been included in the building design without credit. Costs, and cost effectiveness, are not evaluated for individual measures due to the vast number of potential combinations amongst building types, climates, and selected options. Actual costs will vary based on the items selected by the building designer—architects, engineers, and other involved trades—based on the needs and goals of the individual project.

Proposal # 4981

CE226-19

CE227-19

IECC: C406.3

Proponent: Steven Rosenstock, Edison Electric Institute, representing Edison Electric Institute
(srosenstock@eei.org)

2018 International Energy Conservation Code

Revise as follows:

C406.3 Reduced lighting power. The total connected interior lighting power calculated in accordance with Section C405.3.1 shall be less than ~~90-95~~ percent of the total lighting power allowance calculated in accordance with Section C405.3.2.

Reason: In another proposal, the LPD values being proposed for ASHRAE 90.1-2019 (Addendum bb) are proposed for the IECC. This addendum significantly lowers the LPD values in many spaces, due to the following:

- Going from 77% LED / 23% non-LED fixtures in 90.1-2016 modeling to 100% LED fixtures for 90.1-2019.

- Significantly increasing the average baseline efficacy to 110 Lumens / Watt.

- Reducing the target footcandles in common space types for 90.1-2019 compared to 90.1-2016.

(source: ASHRAE Lighting Subcommittee Presentation, August 2018)

Assuming that the other proposal passes, the "floor" of lighting efficiency will have increased significantly, leaving much less "head room" for higher efficiency options.

This proposal make this efficiency option more achievable and more realistic, based on the updated LPD values that are likely to be adopted in the next version of the IECC.

Bibliography: ASHRAE, "ANSI/ASHRAE/IES Standard 90.1 Lighting Model" Presentation, August 2, 2018.

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

This proposal makes this efficiency option more realistic and achievable with available technologies, and will reduce the cost of this option.

Proposal # 4861

CE227-19

CE228-19

IECC: C406, C406.1, C406.3, C406.3.1 (New), C406.3.2 (New)

Proponent: Mark Lyles, representing Northwest Energy Codes Group (markl@newbuildings.org)

2018 International Energy Conservation Code

SECTION C406 ADDITIONAL EFFICIENCY PACKAGE OPTIONS REQUIREMENTS

C406.1 Requirements. ~~Additional energy efficiency requirements.~~ ~~Buildings~~ New buildings shall comply with one or more of the following:

1. More efficient HVAC performance in accordance with Section C406.2.
2. Reduced lighting power in accordance with Section C406.3.
3. Enhanced lighting controls in accordance with Section C406.4.
4. On-site supply of renewable energy in accordance with Section C406.5.
5. Provision of a dedicated outdoor air system for certain HVAC equipment in accordance with Section C406.6.
6. High-efficiency service water heating in accordance with Section C406.7.
7. Enhanced envelope performance in accordance with Section C406.8.
8. Reduced air infiltration in accordance with Section C406.9

Revise as follows:

C406.3 Reduced lighting power. ~~The total connected interior lighting power calculated in accordance with Section C405.3.1 shall be less than 90 percent of the total lighting power allowance calculated in accordance with Section C405.3.2.~~ Buildings shall comply with Section C406.3.1 and dwelling units and sleeping units within the building shall comply with C406.3.2.

Add new text as follows:

C406.3.1 Reduce lighting power by more than 10 percent. The total connected interior lighting power calculated in accordance with Section C405.3.1 shall be less than 90 percent of the total lighting power allowance calculated in accordance with Section C405.3.2.

C406.3.2 Lamp Efficacy Not less than 95 percent of the interior lighting power (watts) from lamps in permanently installed light fixtures in dwelling units and sleeping units shall be provided by lamps with a minimum efficacy of 65 lumens per watt.

Reason: C406 add Dwelling Lighting Efficacy

Currently, a 10% lighting reduction in lighting power allowance is required for this extra efficiency option; however the lighting power concept does not apply to dwelling units and sleeping units, which can follow the residential lighting efficacy requirements. As a result, the applicability of option C406.3 is unclear for multi-family buildings. This measure would make clear the 10% lighting reduction applies to areas in a multi-family building that are not dwelling units and sleeping units and would apply a higher efficacy rating in the dwelling and sleeping units than is required in the residential lighting requirements.

For buildings with residential occupancy, this measure would increase the efficacy requirement for lamps in permanently installed fixtures and make them more in line with lamps available today. This measure provides more clarity for multi-family buildings for the lighting power reduction option. Lamps meeting the higher efficacy

requirement are readily available and appropriate for an optional credit.

Bibliography: Hart, R., R. Nambiar, M. Tyler, M., Y. Xie, and J. Zhang. "Relative Credits for Extra Efficiency Measures: Technical Brief." Pacific Northwest National Laboratory (PNNL), Richland, WA (US), January 2019. https://www.pnnl.gov/main/publications/external/technical_reports/PNNL-28370Rev.1.pdf.

www.1000bulbs.com for lamp prices

Cost Impact: The code change proposal will not increase or decrease the cost of construction. To use this reduced lighting power option to meet C406 requirements in buildings with residential areas this proposal will require higher efficacy lamps in dwelling units and sleeping units. However, these lamps are readily available in the market place, and checking internet sources has found them to actually be less costly than the slightly lower efficacy alternative required under the residential code. LED lamps were found to be about 85% the cost of similar output compact fluorescent lamps. If compared to incandescent lamps, there may be a cost increase, but the life of either the CFL or LED lamps is 10 or 15 times as long, resulting in a much lower cost per year of service.

Actual costs will vary based on the items selected by the building designer—architects, engineers, and other involved trades—based on the needs and goals of the individual project.

Proposal # 5767

CE228-19

CE229-19

IECC: C202, C406.1, TABLE C406.1(1) (New), TABLE C406.1(2) (New), TABLE C406.1(3) (New), TABLE C406.1(4) (New), TABLE C406.1(5) (New), C406.1.1, C406.2, C406.2.1 (New), C406.2.3 (New), C406.2.4 (New), C406.4, C406.5, C406.5.1 (New), C406.5.2 (New), C406.7, C406.7.1 (New), C406.7.1, C406.7.3 (New), C406.7.4 (New)

Proponent: Jonathan McHugh, representing McHugh Energy Consultants Inc. (jon@mchughenergy.com)

2018 International Energy Conservation Code

SECTION C202 GENERAL DEFINITIONS

Add new definition as follows:

LUMEN MAINTENANCE CONTROLS: A lighting control strategy that adjusts luminaire power over time to maintain constant light output as luminaires age, dirt accumulates or both. This strategy allows for energy savings in the life of the system then increases power as the system ages.

HIGH END TRIM: A lighting control strategy that sets the required maximum light level for each space.

SECTION C406 ADDITIONAL EFFICIENCY PACKAGE OPTIONS REQUIREMENTS

C406.1 Requirements. ~~Buildings shall comply~~ New buildings shall achieve a total of 10 credits from Tables C406.1(1) through C406.1(5) where the table is selected based on the use group of the building. Where a building contains multiple use groups, credits from each use group shall be weighted by floor area of each group to determine the weighted average building credit. Alternatively, credits shall be as calculated in accordance the relevant subsection of Section C406. Credits from the tables or calculation shall be achieved where a building complies with one or more of the following:

1. More efficient HVAC performance in accordance with Section C406.2.
2. Reduced lighting power in accordance with Section C406.3.
3. Enhanced lighting controls in accordance with Section C406.4.
4. On-site supply of renewable energy in accordance with Section C406.5.
5. Provision of a dedicated outdoor air system for certain HVAC equipment in accordance with Section C406.6.
6. High-efficiency service water heating in accordance with Section C406.7.
7. Enhanced envelope performance in accordance with Section C406.8.
8. Reduced air infiltration in accordance with Section C406.9.

Add new text as follows:

TABLE C406.1(1)
ADDITIONAL ENERGY EFFICIENCY CREDITS FOR GROUP B OCCUPANCY

Sub-section / Climate Zone:	1A	1B	2A	2B	3A	3B	3C	4A	4B	4C	5A	5B	5C	6 A	6 B	7	8
C406.2.1: 5% Heating Eff Imprv.	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1	NA	NA	1	1	NA	1
C406.2.2: 5% Cooling Eff Imprv.	6	6	5	5	4	4	3	3	3	2	2	2	1	2	2	2	1

C406.2.3: 10 % Heating Eff Imprv.	NA	NA	NA	NA	NA	NA	NA	1	NA	NA	2	1	1	2	2	NA	1
C406.2.4: 10 % Cooling Eff Imprv.	11	12	10	9	7	7	6	5	6	4	4	5	3	4	3	3	3
C406.3: Reduced Light Power	9	8	9	9	9	9	10	8	9	9	7	8	8	6	7	7	6
C406.4: Enh. Digital Light Ctrl	4	4	4	4	4	4	4	3	4	4	3	3	4	3	3	3	3
C406.5.1: On-site Renewable Egy.	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9
C406.6 : Dedicated OA Sys (DOAS)	4	4	4	4	4	3	2	5	3	2	5	3	2	7	4	5	3
C406.7.2: Recovered/Renew SWH	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
C406.7.3: Eff fossil fuel SWH	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
C406.7.4: Heat Pump SWH	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
C406.8: Enhanced Envelope Perf	1	4	2	4	4	3	NA	7	4	5	10	7	6	11	10	14	16
C406.9: Reduced Air Infiltration	2	1	1	2	4	1	NA	8	2	3	11	4	1	15	8	11	6

TABLE C406.1(2)
ADDITIONAL ENERGY EFFICIENCY CREDITS FOR GROUP R AND I OCCUPANCIES

Sub-section / Climate Zone:	1A	1B	2A	2B	3A	3B	3C	4A	4B	4C	5A	5B	5C	6 A	6 B	7	8
C406 .2.1: 5% Heating Eff Imprv.	NA	NA	NA	NA	1	NA	NA	1	NA	1	1	1	1	2	1	2	2
C406 .2.2: 5% Cooling Eff Imprv.	3	3	2	2	1	1	1	1	1	NA	1	1	NA	1	1	1	NA
C406 .2.3: 10 % Heating Eff Imprv.	NA	NA	NA	NA	1	NA	NA	1	1	1	2	2	1	3	2	3	4
C406 .2.4: 10 % Cooling Eff Imprv.	5	5	4	3	2	3	1	2	2	1	1	1	1	1	1	1	1
C406 .3: Reduced Light Power	2	2	2	2	2	2	3	2	2	2	2	2	2	2	2	2	2
C406 .4: Enh. Digital Light Ctrl	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
C406 .5.1: On-site Renewable Egy.	8	8	8	8	7	8	8	7	7	7	7	7	7	7	7	7	7
C406 .6 : Dedicated OA Sys (DOAS)	3	4	3	3	4	2	NA	6	3	4	8	5	5	10	7	11	12
C406 .7.2: Recovered/Renew SWH	10	9	11	10	13	12	15	14	14	15	14	14	16	14	15	15	15
C406 .7.3: Eff fossil fuel SWH	5	5	6	6	8	7	8	8	8	9	9	9	10	10	9	10	11
C406 .7.4: Heat Pump SWH	6	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
C406 .8: Enhanced Envelope Perf	3	6	3	5	4	4	1	4	3	3	4	5	3	5	4	6	6
C406 .9: Reduced Air Infiltration	6	5	3	11	6	4	NA	7	3	3	9	5	1	13	6	8	3

TABLE C406.1(3)
ADDITIONAL ENERGY EFFICIENCY CREDITS FOR GROUP E OCCUPANCY

Sub-section / Climate Zone:	1A	1B	2A	2B	3A	3B	3C	4A	4B	4C	5A	5B	5C	6 A	6 B	7	8
C406.2.1: 5% Heating Eff Imprv.	NA	NA	NA	NA	1	1	1	1	1	2	1	2	1	2	2	3	4
C406.2.2: 5% Cooling Eff Imprv.	4	4	3	3	2	2	2	2	1	1	1	1	NA	1	1	1	NA
C406.2.3: 10 % Heating Eff Imprv.	NA	NA	NA	1	1	1	1	2	3	4	3	4	3	4	3	5	7
C406.2.4: 10 % Cooling Eff Imprv.	7	8	7	6	5	4	3	4	3	1	2	2	1	2	2	2	1
C406.3: Reduced Light Power	8	8	8	9	8	9	9	8	9	9	8	9	8	7	8	7	7
C406.4: Enh. Digital Light Ctrl	3	4	3	4	3	4	3	4	5	4	4	5	3	4	4	3	2
C406.5.1: On-site Renewable Egy.	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	5	5
C406.6 : Dedicated OA Sys (DOAS)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

C406.7.2: Recovered/Renew SWH ^a	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
C406 .7.3: Eff fossil fuel SWH ^a	NA	1	1	1	1	1	1	2	2	3	2	3	2	3	3	3	5
C406 .7.4: Heat Pump SWH ^a	NA	NA	NA	NA	NA	NA	NA	1	NA	NA	1	1	NA	1	1	1	1
C406.8: Enhanced Envelope Perf	3	7	3	4	2	4	1	1	3	1	2	3	NA	4	3	6	9
C406.9: Reduced Air Infiltration	1	1	1	2	NA	NA	NA	NA	NA	NA	1	NA	NA	4	1	4	3

a. For schools with showers or full service kitchens

TABLE C406.1(4)
ADDITIONAL ENERGY EFFICIENCY CREDITS FOR GROUP M OCCUPANCIES

Sub-section / Climate Zone:	1A	1B	2A	2B	3A	3B	3C	4A	4B	4C	5A	5B	5C	6 A	6 B	7	8
C406 .2.1: 5% Heating Eff Imprv.	NA	NA	NA	NA	1	1	NA	1	1	2	2	2	2	3	2	3	4
C406 .2.2: 5% Cooling Eff Imprv.	5	6	4	4	3	3	1	2	2	1	1	2	NA	1	1	1	NA
C406 .2.3: 10 % Heating Eff Imprv.	NA	NA	NA	1	1	1	1	2	2	4	3	4	5	5	3	6	8
C406 .2.4: 10 % Cooling Eff Imprv.	9	12	9	8	6	6	3	4	4	1	2	3	NA	2	2	2	1
C406 .3: Reduced Light Power	13	13	15	14	16	14	17	15	15	14	12	14	14	16	16	14	12
C406 .4: Enh. Digital Light Ctrl	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
C406 .5.1: On-site Renewable Egy.	8	8	8	8	8	8	8	8	8	7	7	7	7	7	7	7	6
C406 .6 : Dedicated OA Sys (DOAS)	3	4	3	3	3	3	1	3	2	2	2	3	2	4	3	4	4
C406 .7.2: Recovered/Renew SWH	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
C406 .7.3: Eff fossil fuel SWH	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
C406 .7.4: Heat Pump SWH	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
C406 .8: Enhanced Envelope Perf	4	6	3	4	3	3	1	6	4	4	4	5	4	6	5	8	9
C406 .9: Reduced Air Infiltration	1	1	1	2	1	1	NA	3	1	1	3	2	1	7	3	6	3

C406.1(5)
TABLE Additional Energy Efficiency Credits for Other^a Occupancies

Sub-section / Climate Zone:	1A	1B	2A	2B	3A	3B	3C	4A	4B	4C	5A	5B	5C	6 A	6 B	7	8
C406.2.1: 5% Heating Eff Imprv.	NA	NA	NA	NA	1	1	1	1	1	2	1	2	1	2	2	3	3
C406.2.2: 5% Cooling Eff Imprv.	5	5	4	4	3	3	2	2	2	1	1	2	1	1	1	1	1
C406.2.3: 10 % Heating Eff Imprv.	NA	NA	NA	1	1	1	1	2	2	3	3	3	3	4	3	5	5
C406.2.4: 10 % Cooling Eff Imprv.	8	9	8	7	5	5	3	4	4	2	2	3	2	2	2	2	2
C406.3: Reduced Light Power	8	8	9	9	9	9	10	8	9	9	7	8	8	8	8	8	7
C406.4: Enh. Digital Light Ctrl	4	4	4	4	4	4	4	4	5	4	4	4	4	4	4	3	3
C406.5.1: On-site Renewable Egy.	8	8	8	8	8	8	8	8	8	7	7	7	7	7	7	7	7
C406.6 : Dedicated OA Sys (DOAS)	3	4	3	3	4	3	2	5	3	3	5	4	3	7	5	7	6
C406.7.2: Recovered/Renew SWH ^b	10	9	11	10	13	12	15	14	14	15	14	14	16	14	15	15	15
C406.7.3: Eff fossil fuel SWH ^b	5	5	6	6	8	7	8	8	8	9	9	9	10	10	9	10	11
C406.7.4: Heat Pump SWH ^b	6	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
C406.8: Enhanced Envelope Perf	3	6	3	4	3	4	1	5	4	3	5	5	4	7	6	9	10

C406.9: Reduced Air Infiltration	<u>3</u>	<u>2</u>	<u>2</u>	<u>4</u>	<u>4</u>	<u>2</u>	<u>NA</u>	<u>6</u>	<u>2</u>	<u>2</u>	<u>6</u>	<u>4</u>	<u>1</u>	<u>10</u>	<u>5</u>	<u>7</u>	<u>4</u>
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a. Other occupancy groups include all Groups except for Groups B, R, I, E, and M.

b. For occupancy groups listed in Section C406.7.1.

C406.1.1 Tenant spaces. Tenant spaces shall comply with sufficient options form Tables C406 .1(1) through C406 .1(5) to achieve a minimum number of 5 credits, where credits are selected from Section C406.2, C406.3, C406.4, C406.6 or C406.7. Alternatively, tenant spaces shall Where the entire building complies using credits from Section C406.5, C406.8 or C406.9 tenant spaces within the buildings shall be deemed to comply with Section C406.5 where the entire building is in compliance.

Exception: Previously occupied tenant spaces that comply with this code in accordance with Section C501.

C406.2 More efficient HVAC equipment performance. Equipment shall exceed the minimum efficiency requirements listed in Tables C403.3.2(1) through C403.3.2(7) ~~by 10 percent, in addition to the requirements of Section C403. Where multiple performance requirements are provided, the equipment shall exceed all requirements by 10 percent.~~ 9) and Variable refrigerant flow systems shall exceed listed in the energy efficiency provisions of ANSI/ASHRAE/IESNA 90.1 by 10 percent. in accordance with Section C406.2.1, C406.2.2, C406.2.3 or C406.2.4. Equipment shall also meet applicable requirements of Section C403. Energy efficiency credits for heating shall be selected from Section C406.2.1 or C406.2.3 and energy efficiency credits for cooling shall be selected from Section C406.2.2 or C406.2.4. Selected credits shall include a heating or cooling energy efficiency credit or both. . Equipment not listed in Tables C403.3.2(1) through C403.3.2(7)-9) and Variable refrigerant flow systems not listed in the energy efficiency provisions of ANSI/ASHRAE/IES 90 .1 shall be limited to 10 percent of the total building system capacity. capacity for heating equipment where selecting Section C406.2.1 or C406.2.3 and cooling equipment where selecting Section C406.2.2 or C406.2.4.

Add new text as follows:

C406.2.1 Five percent heating efficiency improvement Equipment shall exceed the minimum heating efficiency requirements by 5 percent.

C406.2.2 Five percent cooling efficiency improvement Equipment shall exceed the minimum cooling and heat rejection efficiency requirements by 5 percent. Where multiple cooling performance requirements are provided, the equipment shall exceed the annual energy requirement, including IEER, SEER, and IPLV.

C406.2.3 Ten percent heating efficiency improvement Equipment shall exceed the minimum heating efficiency requirements by 10 percent.

C406.2.4 Ten percent cooling efficiency improvement Equipment shall exceed the minimum cooling and heat rejection efficiency requirements by 10 percent. Where multiple cooling performance requirements are provided, the equipment shall exceed the annual energy requirement, including IEER, SEER, and IPLV.

Revise as follows:

C406.4 Enhanced digital lighting controls. ~~Interior lighting in~~ At least 90 percent of the building floor area shall have interior lighting with the following enhanced lighting controls for luminaires providing general lighting, that shall be located, scheduled and operated in accordance with Section C405.2.2- C405.2.

1. Luminaires shall be configured for continuous dimming.
2. Luminaires shall be addressed individually. Where individual addressability is not available for the luminaire class type, a controlled group of not more than four luminaries shall be allowed.

3. Not more than eight luminaires shall be controlled together in a *daylight zone*.
4. Fixtures shall be controlled through a digital control system that includes the following function:
 - 4.1. Control reconfiguration based on digital addressability.
 - 4.2. Load shedding.
 - 4.3. Individual user control of overhead general illumination in open offices.
 - 4.4. Occupancy sensors shall be capable of being reconfigured through the digital control system.
5. Construction documents shall include submittal of a Sequence of Operations, including a specification outlining each of the functions in Item 4.
6. Functional testing of lighting controls shall comply with Section C408. High end trim controls shall be enabled and configured to limit the initial maximum output or maximum power draw of the controlled lighting to 85 percent or less of full light output or full power draw for both of the following:
 - 6.1 All areas that have *lumen maintenance controls*
 - 6.2 50% of the remaining floor area.

C406.5 On-site renewable energy. ~~The total minimum ratings of on-site renewable energy systems shall be one of the following:~~

- ~~1. Not less than 1.71 Btu/h per square foot (5.4 W/m²) or 0.50 watts per square foot (5.4 W/m²) of conditioned floor area.~~
 - ~~2. Not less than 3 percent of the energy used within the building for building mechanical and service water heating equipment and lighting regulated in Chapter 4.~~
- ~~Buildings shall comply with Section C406 .5.1 or C406 .5.2.~~

Add new text as follows:

C406.5.1 Basic renewable credits. The total minimum ratings of on-site renewable energy systems not including systems used for credits under Sections C406.7.2 shall be one of the following:

1. Not less than 0.86 Btu/h per square foot (2.7 W/m²) or 0.25 watts per square foot (2.7 W/m²) of conditioned floor area.
2. Not less than 2 percent of the energy used within the building for building mechanical and service water heating equipment and lighting regulated in Chapter 4.

C406.5.2 Enhanced Renewable Credits Where the total minimum ratings of on-site renewable energy systems exceeds the rating in C406.5.1(1), additional energy efficiency credits shall be determined based on Equation 4-13, rounded to the nearest whole number.

$$AEEC_{RBa} = AEEC_{2.5} \times RB_a / RB_1 \text{ (Equation 4-13)}$$

Where:

$$AEEC_{RBa} = \text{C406 .5.2 additional energy efficiency credits}$$

RB_a = actual total minimum ratings of on-site renewable energy systems in Btu/h, watts per square foot or W/m²)

RB_1 = minimum ratings of on-site renewable energy systems required by C406 .5.1(1) in Btu/h, watts per square foot or W/m²)

$$AEEC_{2.5} = \text{C406 .5.1 credits from Tables C406.1(1) through C406.1(5)}$$

Revise as follows:

C406.7 Reduced energy use in service water heating. Buildings shall comply with Section C406 .7.1 and Section C406.7.2, C406.7.3 or C406 .7.4. be of the following types to use this compliance method:

1. ~~Group R-1: Boarding houses, hotels or motels.~~
2. ~~Group I-2: Hospitals, psychiatric hospitals and nursing homes.~~
3. ~~Group A-2: Restaurants and banquet halls or buildings containing food preparation areas.~~
4. ~~Group F: Laundries.~~
5. ~~Group R-2.~~
6. ~~Group A-3: Health clubs and spas.~~
7. ~~Buildings showing a service hot water load of 10 percent or more of total building energy loads, as shown with an energy analysis as described in Section C407.~~

Add new text as follows:

C406.7.1 Building type. To qualify for this credit, the building shall contain one be of the following use groups and the additional energy efficiency credit shall be prorated by conditioned floor area of the portion of the building comprised of the following use groups:

1. Group R-1: Boarding houses, hotels or motels.
2. Group I-2: Hospitals, psychiatric hospitals and nursing homes.
3. Group A-2: Restaurants and banquet halls or buildings containing food preparation areas.
4. Group F: Laundries.
5. Group R-2.
6. Group A-3: Health clubs and spas.
7. Group E: Schools with full-service kitchens or locker rooms with showers
8. Buildings showing a service hot water load of 10 percent or more of total building energy loads, as shown with an energy analysis as described in Section C407.

~~C406.7.1 C406.7.2 Load fraction.~~ Recovered or renewable water heating. The building service water-heating system shall have one or more of the following that are sized to provide not less than ~~60-30~~ percent of the building's annual hot water requirements, or sized to provide ~~100-70~~ percent of the building's annual hot water requirements if the building ~~shall otherwise is required to~~ comply with Section C403.9.5:

1. Waste heat recovery from service hot water, heat-recovery chillers, building equipment, or process equipment.
2. *On-site renewable energy* water-heating systems.

Add new text as follows:

C406.7.3 Efficient fossil fuel water heater. The combined input-capacity-weighted-average equipment rating of all fossil fuel water heating equipment in the building shall be not less than 95 percent Et or 0.95 EF. This option shall receive only half the listed credits for buildings required to comply with C404.2.1.

C406.7.4 Heat pump water heater. Where electric resistance water heaters are allowed, all service hot water system heating requirements shall be met using heat pump technology with a combined input-capacity-weighted-average EF of 3.0. Air-source heat pump water heaters shall not draw conditioned air from within the building, except exhaust air that would otherwise be exhausted to the exterior.

Reason:

C406 Credits for Enhanced digital lighting controls.

This proposal builds on top of a proposal (CE218-19) that assigns energy efficiency credits to each option in Section C406. For clarity, that entire base proposal is included here. Additional provisions and table row

modifications are as follows:

- The provisions of Enhanced Digital lighting are clarified to require high end trim tuning, including definitions to support those clarifications.
- The credits in the tables are increased for enhanced digital light control based on the clarified provisions in C406.4 that are expected to produce increased savings.

Compared to the existing enhanced lighting controls in C406.4, this proposal provides for more certain savings through light level tuning with the option of lumen maintenance control.

Enhanced lighting controls (Section C406.4) can save more energy by tuning maximum light levels to just what is needed throughout the building. Making this requirement explicit and requiring documentation can actually achieve greater savings.

In the proposed code language, changes are made to allow for the following:

- Definitions are added for lumen maintenance controls and high end trim. These definitions are adapted from NEMA-LSD-64. The high end trim definition exactly matches the NEMA definition, and the lumen maintenance definition is adjusted to refer to luminaire power rather than lamp power.
- The area required with the specified controls is adjusted to 90%. Under current language, all luminaires in the building would need to meet the control requirements. This does not make sense for areas like mechanical and electrical rooms, stairwells, and restrooms, where the specified controls would not provide an energy benefit.
- The specified controls are required only for luminaires providing general lighting.
- A requirement for high end trim was added for any areas with lumen maintenance controls, plus 50% of the remaining area.

High end trim or tuning accounts for the fact that maximum lighting with full output at the lighting power allowance level typically provides more lighting than necessary, due to increments in luminaire size and limits on exact luminaire spacing. Requiring tuning that reduces light levels and power by at least 15%, along with documentation in the lighting functional testing process will reduce actual light power levels. While the original language for this type of control provides the capability to tune, without the trim requirement, there is not a strong argument for savings actually occurring. Lumen maintenance controls also start with a lower light level and adjust the lighting upward to compensate for lumen and dirt depreciation. Requiring tuning to 85% or lower will result in more savings than the savings shown for the existing requirement without this trim language. In the field, tuning down to 70% light and power levels or lower is often possible.

This proposal addresses lumen maintenance controlled luminaires, but does not require lumen maintenance controls. Lumen maintenance controls will adjust the lighting power over time to increase power as the light output reduces from lamp, dirt and room lumen depreciation. This strategy can save average energy over time, but only if the controls are tuned initially. When these controls are applied, all areas with lumen maintenance control require tuning, with half the remaining area also requiring high end trim tuning. Where lumen maintenance controls are not used, the high trim requirement applies to 50% of the lit area.

Note: Tables C406.1(1) through C406.1(5) include entries for climate zones 1A through 8. Should climate zones 0A and 0B be added to the IECC, use values for 1A in 0A and values for 1B in 0B.

Bibliography:

Hart, R., R. Nambiar, M. Tyler, M., Y. Xie, and J. Zhang. "Relative Credits for Extra Efficiency Measures: Technical Brief." Pacific Northwest National Laboratory (PNNL), Richland, WA (US), January 2019.
https://www.pnnl.gov/main/publications/external/technical_reports/PNNL-28370Rev.1.pdf.

Cost Impact: The code change proposal will not increase or decrease the cost of construction. This proposal makes the application easier to implement on the one hand. Making the applicability only to 90% of general lighting reduces the cost. Requiring tuning appears to increase the cost; however, it is currently required by C408 in daylighting areas, so the area where tuning is already required could be equivalent to 50% of the lighting area. In all, this proposal is more a clarification and a reinforcement of tuning requirements that are already found for daylighting areas in Section C408.

Proposal # 5134

CE229-19

CE230-19

IECC: C202, C406, C406.1, C406.4

Proponent: Mark Lyles, representing Northwest Energy Codes Group (markl@newbuildings.org)

2018 International Energy Conservation Code

SECTION C202 GENERAL DEFINITIONS

Add new definition as follows:

LUMEN MAINTENANCE CONTROLS. A lighting control strategy that adjusts luminaire power over time to maintain constant light output as luminaires age, dirt accumulates or both. This strategy allows for energy savings in the life of the system then increases power as the system ages.

HIGH END TRIM. A lighting control strategy that sets the required maximum light level for each space.

SECTION C406 ADDITIONAL EFFICIENCY PACKAGE OPTIONS REQUIREMENTS

C406.1 Requirements- Additional energy efficiency requirements. ~~Buildings~~ New buildings shall comply with one or more of the following:

1. More efficient HVAC performance in accordance with Section C406.2.
2. Reduced lighting power in accordance with Section C406.3.
3. Enhanced lighting controls in accordance with Section C406.4.
4. On-site supply of renewable energy in accordance with Section C406.5.
5. Provision of a dedicated outdoor air system for certain HVAC equipment in accordance with Section C406.6.
6. High-efficiency service water heating in accordance with Section C406.7.
7. Enhanced envelope performance in accordance with Section C406.8.
8. Reduced air infiltration in accordance with Section C406.9

C406.4 Enhanced digital lighting controls. ~~Interior lighting in~~ At least 90 percent of the building floor area shall have interior lighting with the following enhanced lighting controls for luminaires providing general lighting that shall be located, scheduled and operated in accordance with Section ~~C405.2.2- C405.2.~~

1. Luminaires shall be configured for continuous dimming.
2. Luminaires shall be addressed individually. Where individual addressability is not available for the luminaire class type, a controlled group of not more than four luminaries shall be allowed.
3. Not more than eight luminaires shall be controlled together in a *daylight zone*.
4. Fixtures shall be controlled through a digital control system that includes the following function:
 - 4.1. Control reconfiguration based on digital addressability.
 - 4.2. Load shedding.
 - 4.3. Individual user control of overhead general illumination in open offices.
 - 4.4. Occupancy sensors shall be capable of being reconfigured through the digital control system.
5. Construction documents shall include submittal of a Sequence of Operations, including a specification outlining each of the functions in Item 4.

6. Functional testing of lighting controls shall comply with Section C408. High end trim controls shall be enabled and configured to limit the initial maximum output or maximum power draw of the controlled lighting to 85 percent or less of full light output or full power draw for the following:
- 6.1 All areas that have lumen maintenance controls, and
 - 6.2 50% of the remaining floor area.

Reason: C406 revise digital lighting controls:

Compared to the existing enhanced lighting controls in C406.4, the proposal provides for more certain savings through light level tuning with the option of lumen maintenance control. With the clear requirement for tuning in this proposal, the potential savings is more reliable, and the credits listed in this proposal are higher than the credits for this measure in the base proposal for additional energy efficiency credits.

This proposal will improve the C406.4 requirements to provide more energy savings. Enhanced lighting controls (Section C406.4) can save more energy by tuning maximum light levels to just what is needed throughout the building. Making this requirement explicit and requiring documentation can actually achieve greater savings.

In the proposed code language, changes are made to allow for the following:

- Definitions are added for lumen maintenance controls and high end trim. These definitions are adapted from NEMALSD- 64. The high end trim definition exactly matches the NEMA definition, and the lumen maintenance definition is adjusted to refer to luminaire power rather than lamp power.
- The area required with the specified controls is adjusted to 90%. Under current language, all luminaires in the building would need to meet the control requirements. This does not make sense for areas like mechanical and electrical rooms, stairwells, and restrooms, where the specified controls would not provide an energy benefit.
- The specified controls are required only for luminaires providing general lighting.
- A requirement for high end trim was added for any areas with lumen maintenance controls, plus 50% of the remaining area.

High end trim or tuning accounts for the fact that maximum lighting with full output at the lighting power allowance level typically provides more lighting than necessary, due to increments in luminaire size and limits on exact luminaire spacing. Requiring tuning that reduces light levels and power by at least 15%, along with documentation in the lighting functional testing process will reduce actual light power levels. While the original language for this type of control provides the capability to tune, without the trim requirement, there is not a strong argument for savings actually occurring. Lumen maintenance controls also start with a lower light level and adjust the lighting upward to compensate for lumen and dirt depreciation. Requiring tuning to 85% or lower will result in more savings than the savings shown for the existing requirement without this trim language. In the field, tuning down to 70% light and power levels or lower is often possible.

This proposal addresses lumen maintenance controlled luminaires, but does not require lumen maintenance controls. Lumen maintenance controls will adjust the lighting power over time to increase power as the light output reduces from lamp, dirt and room lumen depreciation. This strategy can save average energy over time, but only if the controls are tuned initially. When these controls are applied, all areas with lumen maintenance control require tuning, with half the remaining area also requiring high end trim tuning. Where lumen maintenance controls are not used, the high trim requirement applies to 50% of the lit area.

Bibliography: Hart, R., R. Nambiar, M. Tyler, M., Y. Xie, and J. Zhang. "Relative Credits for Extra Efficiency Measures: Technical Brief." Pacific Northwest National Laboratory (PNNL), Richland, WA (US), January 2019. https://www.pnnl.gov/main/publications/external/technical_reports/PNNL-28370Rev.1.pdf.

Cost Impact: The code change proposal will not increase or decrease the cost of construction. The current proposal does not require more investment, but rather expands existing options permitted under section C406 of the 2018 IECC. The intention is to identify additional options to increase flexibility and more effectively utilize new technologies and construction practices. There is not expected to be an increased cost, as this simply increases the options for C406 beyond what is included in current code. Actual costs will vary based on the items selected by the building designer—architects, engineers, and other involved trades—based on the needs and goals of the individual project.

Proposal # 5769

CE230-19

CE231-19

IECC: C406.4

Proponent: Glenn Heinmiller, Lam Partners, representing International Association of Lighting Designers (glenn@lampartners.com); Jack Bailey, representing International Association of Lighting Designers (jbailey@oneluxstudio.com)

2018 International Energy Conservation Code

Revise as follows:

C406.4 Enhanced digital lighting controls. Interior general lighting in the building shall have the following enhanced lighting controls that shall be located, scheduled and operated in accordance with Section C405.2.2.

1. Luminaires shall be configured for continuous dimming.
2. Luminaires shall be addressed individually. Where individual addressability is not available for the luminaire class type, a controlled group of not more than four luminaries shall be allowed.
3. Not more than eight luminaires shall be controlled together in a daylight zone.
4. Fixtures shall be controlled through a digital control system that includes the following function:
 - 4.1. Control reconfiguration based on digital addressability.
 - 4.2. Load shedding.
 - 4.3. ~~Individual user control of overhead general illumination in open offices.~~ 4.4. Occupancy sensors shall be capable of being reconfigured through the digital control system.
5. Construction documents shall include submittal of a Sequence of Operations, including a specification outlining each of the functions in Item 4.
6. Functional testing of lighting controls shall comply with Section C408.

Reason:

1. As currently written in the code this control requirement would apply to all lighting fixtures in a project. This is not a problem for most fixtures typically used in commercial construction, but there are all sorts of specialized luminaires or decorative luminaires where it would not be sensible, practical, or cost effective to control in this manner. As a solution to this problem, this proposal limits the requirement for Enhanced Digital Lighting controls to *General Lighting*, a defined term in IECC.
2. We also propose to remove the requirement for "individual user control of overhead general illumination in open offices". Giving each occupant in an open office their own control of overhead lighting (it is not clear if this means the lighting only over their desk or over the whole space) might lead to less energy use, but it adds a very high level of complexity to the design, construction, and operation of the lighting system that is unlikely to be cost effective. Control systems that provide this type of control are not commonly available.

Requiring individual user control does not align with the Design Light Consortium technical requirements, which qualifies and provides acceptability guidance for enhanced digital lighting controls. Many in the design and energy program communities will not specify an enhanced digital lighting control system without the controls being listed on the Design Light Consortium's Qualified Product List (QLP) for networked lighting controls.

An application requirement for individual user control is out of context; as this provision is a list of functional enhanced digital lighting controls requirements, which includes luminaire configurability, load shedding and occupancy sensor zoning. Removing individual user control will retain proper functional requirements for the provision.

For these reasons, C406.4 as currently written, is highly unlikely to ever be chosen as an additional efficiency option. Making these changes will greatly increase its usability as an additional efficiency option.

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

Will decrease the cost of construction when C406.4 is applied to open office areas because the code will no longer require the installation of additional lighting controls to provide individual control of overhead lighting.

Proposal # 4664

CE231-19

CE232-19

IECC: C406, TABLE C406.1(1) (New), TABLE C406.1(2) (New), TABLE C406.1(3) (New), TABLE C406.1(4) (New), TABLE C406.1(5) (New), C406.1.1, C406.2, C406.2.1 (New), C406.2.4 (New), C406.5, C406.5.1 (New), C406.7, C406.7.1 (New), C406.7.1, C406.7.3 (New), C406.7.4 (New), C406.10 (New)

Proponent: Sean Denniston (sean@newbuildings.org)

2018 International Energy Conservation Code

Revise as follows:

SECTION C406 ADDITIONAL EFFICIENCY PACKAGE OPTIONS REQUIREMENTS

C406.1 Requirements- Additional energy efficiency credit requirements. Buildings shall comply New buildings shall achieve a total of 10 credits from Tables C406.1(1) through C406.1(5) where the table is selected based on the use group of the building. Where a building contains multiple use groups, credits from each use group shall be weighted by floor area of each group to determine the weighted average building credit. Alternatively, credits shall be as calculated in accordance the relevant subsection of Section C406. Credits from the tables or calculation shall be achieved where a building complies with one or more of the following:

1. More efficient HVAC performance in accordance with Section C406.2.
2. Reduced lighting power in accordance with Section C406.3.
3. Enhanced lighting controls in accordance with Section C406.4.
4. On-site supply of renewable energy in accordance with Section C406.5.
5. Provision of a dedicated outdoor air system for certain HVAC equipment in accordance with Section C406.6.
6. High-efficiency service water heating in accordance with Section C406.7.
7. Enhanced envelope performance in accordance with Section C406.8.
8. Reduced air infiltration in accordance with Section C406.9
9. Controlled receptacles in accordance with Section C406.10

Add new text as follows:

TABLE C406.1(1)
ADDITIONAL ENERGY EFFICIENCY CREDITS FOR GROUP B OCCUPANCIES

Sub-section / Climate Zone:	1A	1B	2A	2B	3A	3B	3C	4A	4B	4C	5A	5B	5C	6 A	6 B	7	8
C406.2.1: 5% Heating Eff Imprv.	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1	NA	NA	1	1	NA	1
C406.2.2: 5% Cooling Eff Imprv.	6	6	5	5	4	4	3	3	3	2	2	2	1	2	2	2	1
C406.2.3: 10 % Heating Eff Imprv.	NA	NA	NA	NA	NA	NA	NA	1	NA	NA	2	1	1	2	2	NA	1
C406.2.4: 10 % Cooling Eff Imprv.	11	12	10	9	7	7	6	5	6	4	4	5	3	4	3	3	3
C406.3: Reduced Light Power	9	8	9	9	9	9	10	8	9	9	7	8	8	6	7	7	6
C406.4: Enh. Digital Light Ctrl	2	2	2	2	2	2	2	2	2	2	2	2	2	1	2	1	1
C406.5.1: On-site Renewable Egy.	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9
C406.6 : Dedicated OA Sys (DOAS)	4	4	4	4	4	3	2	5	3	2	5	3	2	7	4	5	3
C406.7.2: Recovered/Renew SWH	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

C406.7.3: Eff fossil fuel SWH	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
C406.7.4: Heat Pump SWH	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
C406.8: Enhanced Envelope Perf	1	4	2	4	4	3	NA	7	4	5	10	7	6	11	10	14	16
C406.9: Reduced Air Infiltration	2	1	1	2	4	1	NA	8	2	3	11	4	1	15	8	11	6
C406.10 Controlled Receptacles	15	14	15	15	14	15	17	12	15	13	11	13	13	10	12	10	9

TABLE C406.1(2)
ADDITIONAL ENERGY EFFICIENCY CREDITS FOR GROUP R AND I OCCUPANCIES

Sub-section / Climate Zone:	1A	1B	2A	2B	3A	3B	3C	4A	4B	4C	5A	5B	5C	6 A	6 B	7	8
C406.2.1: 5% Heating Eff Imprv.	NA	NA	NA	NA	1	NA	NA	1	NA	1	1	1	1	2	1	2	2
C406.2.2: 5% Cooling Eff Imprv.	3	3	2	2	1	1	1	1	1	NA	1	1	NA	1	1	1	NA
C406.2.3: 10 % Heating Eff Imprv.	NA	NA	NA	NA	1	NA	NA	1	1	1	2	2	1	3	2	3	4
C406.2.4: 10 % Cooling Eff Imprv.	5	5	4	3	2	3	1	2	2	1	1	1	1	1	1	1	1
C406.3: Reduced Light Power	2	2	2	2	2	2	3	2	2	2	2	2	2	2	2	2	2
C406.4: Enh. Digital Light Ctrl	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
C406.5.1: On-site Renewable Egy.	8	8	8	8	7	8	8	7	7	7	7	7	7	7	7	7	7
C406.6 : Dedicated OA Sys (DOAS)	3	4	3	3	4	2	NA	6	3	4	8	5	5	10	7	11	12
C406.7.2: Recovered/Renew SWH	10	9	11	10	13	12	15	14	14	15	14	14	16	14	15	15	15
C406.7.3: Eff fossil fuel SWH	5	5	6	6	8	7	8	8	8	9	9	9	10	10	9	10	11
C406.7.4: Heat Pump SWH	6	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
C406.8: Enhanced Envelope Perf	3	6	3	5	4	4	1	4	3	3	4	5	3	5	4	6	6
C406.9: Reduced Air Infiltration	6	5	3	11	6	4	NA	7	3	3	9	5	1	13	6	8	3
C406.10 Controlled Receptacles	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

TABLE C406.1(3)
ADDITIONAL ENERGY EFFICIENCY CREDITS FOR GROUP E OCCUPANCIES

Sub-section / Climate Zone:	1A	1B	2A	2B	3A	3B	3C	4A	4B	4C	5A	5B	5C	6 A	6 B	7	8
C406.2.1: 5% Heating Eff Imprv.	NA	NA	NA	NA	1	1	1	1	1	2	1	2	1	2	2	3	4
C406.2.2: 5% Cooling Eff Imprv.	4	4	3	3	2	2	2	2	1	1	1	1	NA	1	1	1	NA
C406.2.3: 10 % Heating Eff Imprv.	NA	NA	NA	1	1	1	1	2	3	4	3	4	3	4	3	5	7
C406.2.4: 10 % Cooling Eff Imprv.	7	8	7	6	5	4	3	4	3	1	2	2	1	2	2	2	1
C406.3: Reduced Light Power	8	8	8	9	8	9	9	8	9	9	8	9	8	7	8	7	7
C406.4: Enh. Digital Light Ctrl	2	2	2	2	2	2	2	2	2	2	2	3	2	2	2	2	1
C406.5.1: On-site Renewable Egy.	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	5	5
C406.6 : Dedicated OA Sys (DOAS)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
C406.7.2: Recovered/Renew SWH ^a	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
C406.7.3: Eff fossil fuel SWH ^a	NA	1	1	1	1	1	1	2	2	3	2	3	2	3	3	3	5
C406.7.4: Heat Pump SWH ^a	NA	NA	NA	NA	NA	NA	NA	1	NA	NA	1	1	NA	1	1	1	1
C406.8: Enhanced Envelope Perf	3	7	3	4	2	4	1	1	3	1	2	3	NA	4	3	6	9

C406.9: Reduced Air Infiltration	1	1	1	2	NA	NA	NA	NA	NA	NA	1	NA	NA	4	1	4	3
C406.10 Controlled Receptacles	20	19	20	20	20	21	22	20	21	21	20	20	21	18	19	17	15

a. For schools with showers or full service kitchens

TABLE C406.1(4)
ADDITIONAL ENERGY EFFICIENCY CREDITS FOR OTHER GROUP OCCUPANCIES

Sub-section / Climate Zone:	1A	1B	2A	2B	3A	3B	3C	4A	4B	4C	5A	5B	5C	6A	6B	7	8
C406.2.1: 5% Heating Eff Imprv.	NA	NA	NA	NA	1	1	NA	1	1	2	2	2	2	3	2	3	4
C406.2.2: 5% Cooling Eff Imprv.	5	6	4	4	3	3	1	2	2	1	1	2	NA	1	1	1	NA
C406.2.3: 10 % Heating Eff Imprv.	NA	NA	NA	1	1	1	1	2	2	4	3	4	5	5	3	6	8
C406.2.4: 10 % Cooling Eff Imprv.	9	12	9	8	6	6	3	4	4	1	2	3	NA	2	2	2	1
C406.3: Reduced Light Power	13	13	15	14	16	14	17	15	15	14	12	14	14	16	16	14	12
C406.4: Enh. Digital Light Ctrl	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
C406.5.1: On-site Renewable Egy.	8	8	8	8	8	8	8	8	8	7	7	7	7	7	7	7	6
C406.6 : Dedicated OA Sys (DOAS)	3	4	3	3	3	3	1	3	2	2	2	3	2	4	3	4	4
C406.7.2: Recovered/Renew SWH	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
C406.7.3: Eff fossil fuel SWH	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
C406.7.4: Heat Pump SWH	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
C406.8: Enhanced Envelope Perf	4	6	3	4	3	3	1	6	4	4	4	5	4	6	5	8	9
C406.9: Reduced Air Infiltration	1	1	1	2	1	1	NA	3	1	1	3	2	1	7	3	6	3
C406.10 Controlled Receptacles	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

TABLE C406.1(5)
ADDITIONAL ENERGY EFFICIENCY CREDITS FOR OTHER^A OCCUPANCIES

Sub-section / Climate Zone:	1A	1B	2A	2B	3A	3B	3C	4A	4B	4C	5A	5B	5C	6A	6B	7	8
C406.2.1: 5% Heating Eff Imprv.	NA	NA	NA	NA	1	1	1	1	1	2	1	2	1	2	2	3	3
C406.2.2: 5% Cooling Eff Imprv.	5	5	4	4	3	3	2	2	2	1	1	2	1	1	1	1	1
C406.2.3: 10 % Heating Eff Imprv.	NA	NA	NA	1	1	1	1	2	2	3	3	3	3	4	3	5	5
C406.2.4: 10 % Cooling Eff Imprv.	8	9	8	7	5	5	3	4	4	2	2	3	2	2	2	2	2
C406.3: Reduced Light Power	8	8	9	9	9	9	10	8	9	9	7	8	8	8	8	8	7
C406.4: Enh. Digital Light Ctrl	2	2	2	2	2	2	2	2	2	2	2	3	2	2	2	2	1
C406.5.1: On-site Renewable Egy.	8	8	8	8	8	8	8	8	8	7	7	7	7	7	7	7	7
C406.6 : Dedicated OA Sys (DOAS)	3	4	3	3	4	3	2	5	3	3	5	4	3	7	5	7	6
C406.7.2: Recovered/Renew SWH ^b	10	9	11	10	13	12	15	14	14	15	14	14	16	14	15	15	15
C406.7.3: Eff fossil fuel SWH ^b	5	5	6	6	8	7	8	8	8	9	9	9	10	10	9	10	11
C406.7.4: Heat Pump SWH ^b	6	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
C406.8: Enhanced Envelope Perf	3	6	3	4	3	4	1	5	4	3	5	5	4	7	6	9	10
C406.9: Reduced Air Infiltration	3	2	2	4	4	2	NA	6	2	2	6	4	1	10	5	7	4
C406.10 Controlled Receptacles	18	17	18	18	17	18	20	16	18	17	16	17	17	14	16	14	12

a. Other occupancy groups include all Groups except for Groups B, R, I, E, and M.

b. For occupancy groups listed in C406 .7.1.

C406.1.1 Tenant spaces. Tenant spaces shall comply with sufficient options form Tables C406 .1(1) through C406 .1(5) to achieve a minimum number of 5 credits, where credits are selected from Section C406.2, C406.3, C406.4, C406.6 or C406.7. Alternatively, C406.7 or C406.10. Where the entire building complies using credits from Section C406 .5, C406 .8 or C406 .9, tenant spaces within the building shall be deemed to comply with Section C406.5 where the entire building is in compliance. this section.

Exception: Previously occupied tenant spaces that comply with this code in accordance with Section C501.

Revise as follows:

C406.2 More efficient HVAC equipment performance. Equipment shall exceed the minimum efficiency requirements listed in Tables C403.3.2(1) through C403.3.2(7) by 10 percent, in addition to the requirements of Section C403. Where multiple performance requirements are provided, the equipment shall exceed all requirements by 10 percent. 9) and Variable refrigerant flow systems shall exceed listed in the energy efficiency provisions of ANSI/ASHRAE/IESNA 90.1 by 10 percent. in accordance with Sections C406 .2.1, C406 .2.2, C406 .2.3 or C406 .2.4. Equipment shall also meet applicable requirements of Section C403. Energy efficiency credits for heating shall be selected from Section C406 .2.1 or C406 .2.3 and energy efficiency credits for cooling shall be selected from Section C406 .2.2 or C406 .2.4. Selected credits shall include a heating or cooling energy efficiency credit or both. . Equipment not listed in Tables C403.3.2(1) through C403.3.2(7) 9) and Variable refrigerant flow systems not listed in the energy efficiency provisions of ANSI/ASHRAE/IES 90 .1 shall be limited to 10 percent of the total building system capacity. capacity for heating equipment where selecting Section C406 .2.1 or C406 .2.3 and cooling equipment where selecting Section C406 .2.2 or C406 .2.4.

Add new text as follows:

C406.2.1 Five percent heating efficiency improvement. Equipment shall exceed the minimum heating efficiency requirements by 5 percent.

C406.2.2 Five percent cooling efficiency improvement Equipment shall exceed the minimum cooling and heat rejection efficiency requirements by 5 percent. Where multiple cooling performance requirements are provided, the equipment shall exceed the annual energy requirement, including IEER, SEER, and IPLV.

C406.2.3 Ten percent heating efficiency improvement Equipment shall exceed the minimum heating efficiency requirements by 10 percent.

C406.2.4 Ten percent cooling efficiency improvment Equipment shall exceed the minimum cooling and heat rejection efficiency requirements by 10 percent. Where multiple cooling performance requirements are provided, the equipment shall exceed the annual energy requirement, including IEER, SEER, and IPLV.

C406.5 On-site renewable energy. Buildings shall comply with Section C406 .5.1 or C406 .5.2. The total minimum ratings of on-site renewable energy systems shall be one of the following:

1. Not less than 1.71 Btu/h per square foot (5.4 W/m²) or 0.50 watts per square foot (5.4 W/m²) of conditioned floor area.
2. Not less than 3 percent of the energy used within the building for building mechanical and service water heating equipment and lighting regulated in Chapter 4.

Add new text as follows:

C406.5.1 Basic renewable credits The total minimum ratings of on-site renewable energy systems, not including systems used for credits under Section C406.7.2, shall be one of the following:

1. Not less than 0.86 Btu/h per square foot (2.7 W/m²) or 0.25 watts per square foot (2.7 W/m²) of conditioned floor area.
2. Not less than 2 percent of the energy used within the building for building mechanical and service water heating equipment and lighting regulated in Chapter 4.

C406.5.2 Enhanced renewable credit. Where the total minimum ratings of on-site renewable energy systems exceeds the rating in Item 1 of Section C406 .5.1, additional energy efficiency credits shall be determined based on Equation 4-13, rounded to the nearest whole number.

$$AEEC_{RRa} = AEEC_{2.5} \times RR_a / RR_1 \text{ (Equation 4-13)}$$

Where:

$AEEC_{RRa}$ = C406 .5.2 additional energy efficiency credits

RR_a = actual total minimum ratings of *on-site renewable energy* systems (in Btu/h, watts per square foot or W/m²)

RR_1 = minimum ratings of *on-site renewable energy* systems required by C406.5.1(1) (in Btu/h, watts per square foot or W/m²)

$AEEC_{2.5}$ = C406.5.1 credits from Tables C406 1(1) through C406.1(5)

Revise as follows:

C406.7 Reduced energy use in service water heating. Buildings shall comply with Section C406.7.1 and Section C406.7.2, C406.7.3 or C406.7.4. be of the following types to use this compliance method:

1. ~~Group R-1: Boarding houses, hotels or motels.~~
2. ~~Group I-2: Hospitals, psychiatric hospitals and nursing homes.~~
3. ~~Group A-2: Restaurants and banquet halls or buildings containing food preparation areas.~~
4. ~~Group F: Laundries.~~
5. ~~Group R-2.~~
6. ~~Group A-3: Health clubs and spas.~~
7. ~~Buildings showing a service hot water load of 10 percent or more of total building energy loads, as shown with an energy analysis as described in Section C407.~~

Add new text as follows:

C406.7.1 Building type. To qualify for this credit, the building shall contain one of the following use groups and the additional energy efficiency credit shall be prorated by conditioned floor area of the portion of the building comprised of the following use group:

1. Group R-1: Boarding houses, hotels or motels.
2. Group I-2: Hospitals, psychiatric hospitals and nursing homes.
3. Group A-2: Restaurants and banquet halls or buildings containing food preparation areas.
4. Group F: Laundries.
5. Group R-2.
6. Group A-3: Health clubs and spas.
7. Group E: Schools with full-service kitchens or locker rooms with showers
8. Buildings showing a service hot water load of 10 percent or more of total building energy loads, as shown with an energy analysis as described in Section C407.

~~C406.7.1 C406.7.2~~ Load fraction. Recovered or renewable water heating. The building service water-heating system shall have one or more of the following that are sized to provide not less than ~~60-30~~ percent of the building's annual hot water requirements, or sized to provide ~~100-70~~ percent of the building's annual hot water requirements if the building ~~shall otherwise be required to~~ comply with Section C403.9.5:

1. Waste heat recovery from service hot water, heat-recovery chillers, building equipment, or process equipment.
2. *On-site renewable energy* water-heating systems.

Add new text as follows:

C406.7.3 Efficient fossil fuel water heater. The combined input-capacity-weighted-average equipment rating of all fossil fuel water heating equipment in the building shall be not less than 95 percent Et or 0.95 EF. This option shall receive only half the listed credits for buildings required to comply with Section C404.2.1.

C406.7.4 Heat pump water heater. Where electric resistance water heaters are allowed, all service hot water system heating requirements shall be met using heat pump technology with a combined input-capacity-weighted-average EF of 3.0. Air-source heat pump water heaters shall not draw conditioned air from within the building, except exhaust air that would otherwise be exhausted to the exterior.

C406.10 Controlled Receptacles At least 50 percent of all 125 volt 15- and 20-ampere receptacles installed in private offices, open offices, conference rooms, breakrooms, individual workstations, and classrooms, including those installed in modular partitions and modular office workstation systems, shall be controlled as required by this section. Either split receptacles shall be provided, with the top receptacle(s) controlled, or a controlled receptacle shall be located within 12 inches (0.3 m) of each uncontrolled receptacle. Alternatively, non-controlled receptacles in a single modular workstation shall be located not more than 72 inches from a controlled receptacle serving that workstation. Controlled receptacles shall be visibly differentiated from standard receptacles and shall be controlled by one of the following automatic control devices:

1. An occupant sensor that turns receptacle power off when no occupants have been detected for a maximum of 20 minutes.
2. A time-of-day operated control device that turns receptacle power off at specific programmed times and can be programmed separately for each day of the week. The control device shall be capable of providing an independent schedule for each portion of the building not to exceed 5,000 square feet (460 m²) and not to exceed one full floor. The device shall be capable of being overridden for periods of up to two hours by an override switch accessible to occupants. Any individual override switch shall control the controlled receptacles for a maximum area of 5,000 square feet (460 m²).

Exception: Receptacles designated for specific equipment requiring 24-hour operation, for building maintenance functions, or for specific safety or security equipment.

Reason: C406 Credits for Controlled Receptacles

This proposal builds on top of a proposal that assigns energy efficiency credits to each option in Section C406 (CE218-19). For clarity, that entire base proposal is included here with the following additions or changes:

- Requirements for automatic receptacle controls when extra credits are used for this option in the building.
- Table row additions that provide additional energy efficiency credits for controlled receptacles.
- Addition of this option to the items allowed for tenant spaces.

Note: Tables C406.1(1) through C406.1(5) include entries for climate zones 1A through 8. Should climate zones 0A and 0B be added to the IECC, use values for 1A in 0A and values for 1B in 0B.

The code change proposal would provide a credit if occupancy sensor or a time-of-day control devices are

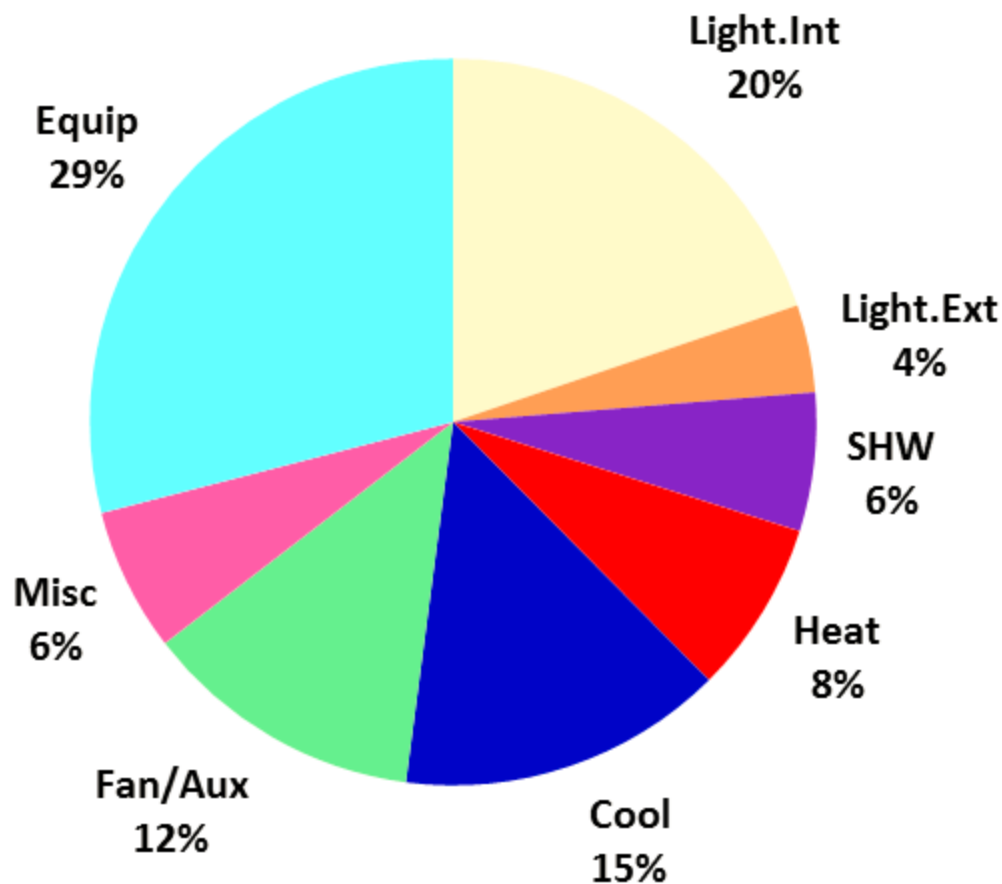
placed on 50% of receptacles installed in private offices, open offices, conference rooms, breakrooms, individual workstations, and classrooms, including those installed in modular partitions and modular office workstation systems. This proposed option is designed to be consistent with the C406 Points Option submitted by the Northwest Energy Codes Group and is based on the PNNL Technical Brief “Relative Credits for Extra Efficiency Code Measures” which can be accessed at http://www.pnnl.gov/main/publications/external/technical_reports/PNNL-28370.pdf.

This measure provides more flexibility to building designers when it is added to the energy efficiency credit choices. The recommended language requires location of controlled receptacles adjacent to non-controlled receptacles. That requirement would avoid “daisy chained” power strips and extension cords from the non-controlled receptacles to their office equipment to avoid their equipment from being automatically turned off. The recommended language was adopted by the Seattle Nonresidential Energy Code and would require that either a split receptacle be installed that would contain both a controlled and uncontrolled receptacle, or the uncontrolled receptacle be located no more than 12” from the controlled receptacle.

Savings Estimate

Controlled receptacles saves energy by turning off unneeded equipment during unoccupied hours. As shown in Figure 3, office equipment is one of the highest energy costs in typical buildings representing 29% of the total cost on a building (Hart and Xie 2014). While the efficiency of office equipment is increasing it still represents a proportionally higher percentage of energy usage in buildings today.

The estimated savings are estimated to be 0.49 kWh/ft² in small office and 0.61 kWh/ft² in large office spaces through reduced equipment run times and other plug loads that are connected to the receptacle. These requirements are currently in ASHRAE Standard 90.1-2016, in the Washington State Nonresidential Energy Code and the Seattle Energy Code.



Bibliography:

Hart, R., R. Nambiar, M. Tyler, M., Y. Xie, and J. Zhang. "Relative Credits for Extra Efficiency Measures: Technical Brief." Pacific Northwest National Laboratory (PNNL), Richland, WA (US), January 2019.
https://www.pnnl.gov/main/publications/external/technical_reports/PNNL-28370Rev.1.pdf.

Hart R and Y Xie. 2014. *End-Use Opportunity Analysis from Progress Indicator Results for ASHRAE Standard 90.1-2013*. PNNL-24043, Pacific Northwest National Laboratory, Richland, WA.
http://www.pnnl.gov/main/publications/external/technical_reports/PNNL-24043.pdf

Cost Impact: The code change proposal will not increase or decrease the cost of construction. Because Controlled Recetacles are an option as part of proposed credits for additional energy efficiency requirements, there is no requirement to comply with this provision. Designers and code users will have the option to use this credit based on project need and cost. Adding the option may reduce costs where this option is lower in cost than the current C406 options.

Proposal # 5159

CE232-19

CE233-19

IECC: C406.10 (New), SECTION C406, C406.1, C406.1.1

Proponent: Harold Jepsen, representing National Electrical Manufacturers Association
(harold.jepsen@legrand.us)

2018 International Energy Conservation Code

Add new text as follows:

C406.10 Automation Receptacle Control The following shall be automatically controlled:

1. At least 50% of all 125 V, 15 and 20-amp receptacles installed in enclosed offices, conference rooms, rooms used primarily for copy and/or print functions, breakrooms, classrooms, and individual workstations, including those installed in modular partitions and module office workstation systems.
2. At least 25% of branch circuit feeders installed for modular furniture not shown on the construction documents.
3. Either split controlled receptacles shall be provided, with the top receptacle controlled, or a controlled receptacle shall be located within 12 inches of each uncontrolled receptacle.

This control shall function on:

1. A scheduled basis using a time-of-day operated control device that turns receptacle power off at specific programmed times and can be programmed separately for each day of the week. The control device shall be configured to provide an independent schedule for each portion of the building of not more than 5000 ft² and not more than one floor. The occupant shall be able to manually override an area for not more than two hours. Any individual override switch shall control the receptacles of not more than 5000 ft
2. An occupant sensor control that shall turn receptacles off within 20 minutes of all occupants leaving a space; or
3. An automated signal from another control or alarm system that shall turn receptacles off within 20 minutes after determining that the area is unoccupied.

All controlled receptacles shall be permanently marked in accordance with NFPA 70 and be uniformly distributed throughout the space. Plug-in devices shall not comply.

Exceptions: Receptacles for the following shall not require an automatic control device:

1. Receptacles specifically designated for equipment requiring continuous operation (24/day, 365 days/year).
2. Spaces where an automatic control would endanger the safety or security of the room or building occupants.
3. Within a single modular office workstation, non-controlled receptacles are permitted to be located more than 12 inches, but not more than 72 inches from the controlled receptacles serving that workstation.

SECTION C406 ADDITIONAL EFFICIENCY PACKAGE OPTIONS

Revise as follows:

C406.1 Requirements. Buildings shall comply with one or more of the following:

1. More efficient HVAC performance in accordance with Section C406.2.
2. Reduced lighting power in accordance with Section C406.3.
3. Enhanced lighting controls in accordance with Section C406.4.
4. On-site supply of renewable energy in accordance with Section C406.5.
5. Provision of a dedicated outdoor air system for certain HVAC equipment in accordance with Section C406.6.
6. High-efficiency service water heating in accordance with Section C406.7.
7. Enhanced envelope performance in accordance with Section C406.8.
8. Reduced air infiltration in accordance with Section C406.9.
9. Automatic receptacle control in accordance with Section C406.10.

C406.1.1 Tenant spaces. Tenant spaces shall comply with Section C406.2, C406.3, C406.4, C406.6, C406.7 or ~~C406.7, C406.10.~~ Alternatively, tenant spaces shall comply with Section C406.5 where the entire building is in compliance.

Exception: Previously occupied tenant spaces that comply with this code in accordance with Section C501.

Reason: This proposal will:

1. Increase building energy efficiency
2. Offer a well-studied, cost effective efficiency measure
3. Maintain building occupant's safe usability
4. Keep enforceability simple
5. Align with other energy efficiency codes, increasing design compliance

Although commercial buildings continue to decrease their energy use through more efficient lighting, mechanical, and domestic water systems, the Miscellaneous Electrical Loads (MELs) energy segment continues to rise. More and more electrical power consuming devices are being plugged into building electrical systems. Some, such as fans, space heaters, printers, monitors, plug-in lamps are left on, when spaces are unoccupied. Other devices may be left plugged in and continue to draw power even when inactive or in standby modes. This wastes energy and is counter to the energy efficiency aim of the IECC.

Further explanation of this proposal can be read in the attachment.

Cost Impact: The code change proposal will increase the cost of construction. Costs estimated to be \$0.26/ft² for small office implementation and \$0.19/ft² for large office. Payback estimated at 4.2 years for small office buildings (10,000sqft) and 2.4 years for large office buildings (100,000sqft). Source: 2013 California Building Energy Efficiency Standards CASE report.

Proposal # 4365

CE233-19

CE234-19

IECC: SECTION C406, C406.1, C406.1.1, C406.10 (New)

Proponent: Mark Lyles, representing Northwest Energy Codes Group (markl@newbuildings.org)

2018 International Energy Conservation Code

SECTION C406 ADDITIONAL EFFICIENCY PACKAGE OPTIONS REQUIREMENTS

~~C406.1 Requirements.~~ Additional energy efficiency requirements. ~~Buildings~~ New buildings shall comply with one or more of the following:

1. More efficient HVAC performance in accordance with Section C406.2.
2. Reduced lighting power in accordance with Section C406.3.
3. Enhanced lighting controls in accordance with Section C406.4.
4. On-site supply of renewable energy in accordance with Section C406.5.
5. Provision of a dedicated outdoor air system for certain HVAC equipment in accordance with Section C406.6.
6. High-efficiency service water heating in accordance with Section C406.7.
7. Enhanced envelope performance in accordance with Section C406.8.
8. Reduced air infiltration in accordance with Section C406.9.
9. Controlled receptacles in accordance with Section C406.10.

C406.1.1 Tenant spaces. Tenant spaces shall comply with Section C406.2, C406.3, C406.4, C406.6 ~~or C406.7. Alternatively, C406.7 or C406.10.~~ Where the entire building complies using credits from Section C406.5, C406.8 or C406.9, tenant spaces within the building shall be deemed to comply with Section C406.5 where the entire building is in compliance. ~~this section.~~

Exception: Previously occupied tenant spaces that comply with this code in accordance with Section C501.

Add new text as follows:

C406.10 Controlled Receptacles At least 50 percent of all 125 volt 15- and 20-ampere receptacles installed in private offices, open offices, conference rooms, breakrooms, individual workstations, and classrooms, including those installed in modular partitions and modular office workstation systems, shall be controlled as required by this section. Either split receptacles shall be provided, with the top receptacle(s) controlled, or a controlled receptacle shall be located within 12 inches (0.3 m) of each uncontrolled receptacle. Alternatively, non-controlled receptacles in a single modular workstation shall be located not more than 72 inches from a controlled receptacle serving that workstation. Controlled receptacles shall be visibly differentiated from standard receptacles and shall be controlled by one of the following automatic control devices:

1. An occupant sensor that turns receptacle power off when no occupants have been detected for a maximum of 20 minutes, or
2. A time-of-day operated control device that turns receptacle power off at specific programmed times and can be programmed separately for each day of the week. The control device shall be capable of providing an independent schedule for each portion of the building not to exceed 5,000 square feet (460 m²) and not to exceed one full floor. The device shall be capable of being overridden for periods of up to two hours by an override switch accessible to occupants. Any individual override switch shall control the controlled receptacles for a maximum area of 5,000 (460 m²).

Exception: Receptacles designated for specific equipment requiring 24-hour operation, for building

maintenance functions, or for specific safety or security equipment..

Reason:

C406 add Controlled Receptacles

This proposal adds a new option in Section C406, increasing flexibility in meeting this additional efficiency requirement. This proposal allows selection of a provision where occupancy sensor or a time-of-day control devices are placed on 50% of receptacles installed in private offices, open offices, conference rooms, breakrooms, individual workstations, and classrooms, including those installed in modular partitions and modular office workstation systems. Modifications include:

- A new subsection added to C406 with provisions for automatic receptacle control.
- The tenant space requirements in C406.1.1 are revised to allow this new option in tenant spaces.

This measure provides more flexibility to building designers when it is added to the energy efficiency requirement choices. The recommended language requires location of controlled receptacles adjacent to non-controlled receptacles. That requirement would avoid “daisy chained” power strips and extension cords from the non-controlled receptacles to their office equipment to avoid their equipment from being automatically turned off. The recommended language was adopted by the Seattle Nonresidential Energy Code and would require that either a split receptacle be installed that would contain both a controlled and uncontrolled receptacle, or the uncontrolled receptacle be located no more than 12” from the controlled receptacle.

Savings Estimate

Controlled receptacles saves energy by turning off unneeded equipment during unoccupied hours. As shown in Figure 1, office equipment is one of the highest energy costs in typical buildings representing 29% of the total cost on a building (Hart and Xie 2014). While the efficiency of office equipment is increasing it still represents a proportionally higher percentage of energy usage in buildings today.

The estimated savings are estimated to be 0.49 kWh/ft² in small office and 0.61 kWh/ft² in large office spaces through reduced equipment run times and other plug loads that are connected to the receptacle. These requirements are currently in ASHRAE Standard 90.1-2016, in the Washington State Nonresidential Energy Code, and the Seattle Energy Code.

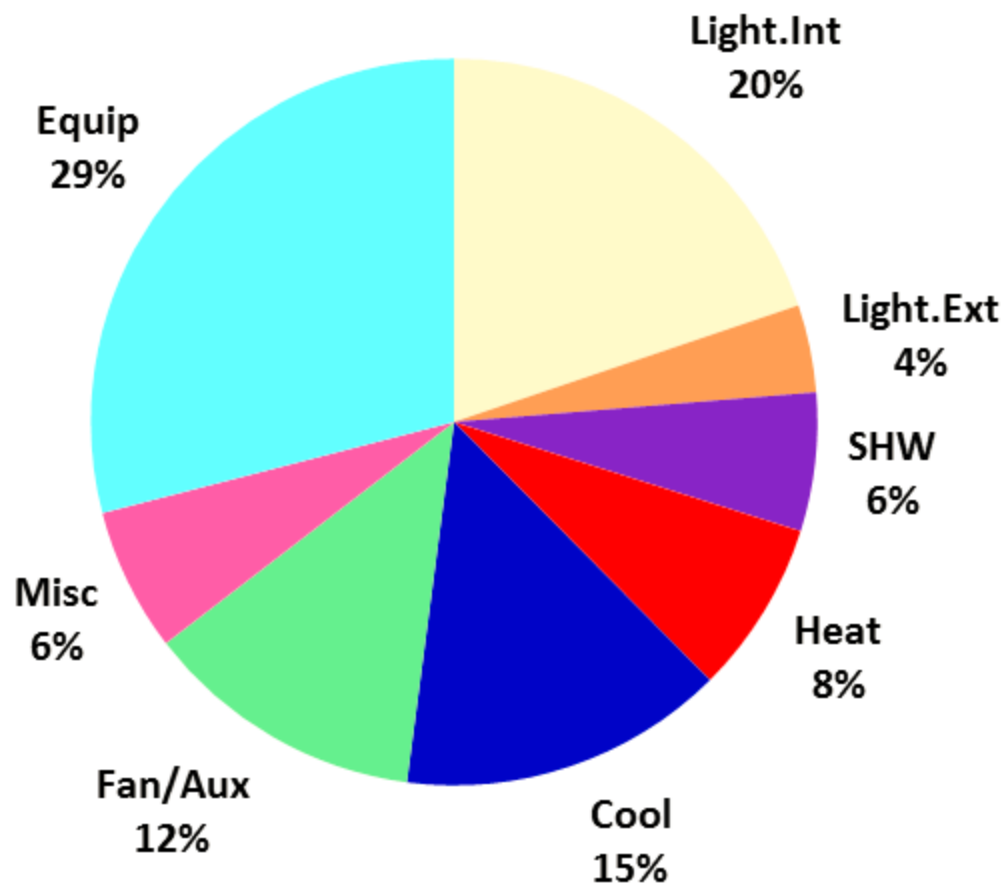


Figure 1. End-use cost for buildings in all U.S. climate zones

Bibliography:

Savings is reported in:

Hart, R., R. Nambiar, M. Tyler, M., Y. Xie, and J. Zhang. "Relative Credits for Extra Efficiency Measures: Technical Brief." Pacific Northwest National Laboratory (PNNL), Richland, WA (US), January 2019. https://www.pnnl.gov/main/publications/external/technical_reports/PNNL-28370Rev.1.pdf.

Hart R and Y Xie. 2014. *End-Use Opportunity Analysis from Progress Indicator Results for ASHRAE Standard 90.1-2013*. PNNL-24043, Pacific Northwest National Laboratory, Richland, WA. http://www.pnnl.gov/main/publications/external/technical_reports/PNNL-24043.pdf

Cost Impact: The code change proposal will not increase or decrease the cost of construction. Because Controlled Receptacles are an option in section C406, there is no requirement to comply with this provision. Designers and code users will have the option to use this option based on project need and cost. The intention is to identify additional options to increase flexibility and more effectively utilize new technologies and construction practices. There is not expected to be an increased cost, as this simply increases the options for C406 beyond what is included in current

code. Actual costs will vary based on the items selected by the building designer—architects, engineers, and other involved trades—based on the needs and goals of the individual project.

Proposal # 5768

CE234-19

CE235-19

IECC: SECTION C406, C406.1, Table C406.1(1) (New), Table C406.1(2) (New), Table C406.1(3) (New), Table C406.1(4) (New), Table C406.1(5) (New), C406.1.1, C406.2, C 406.2.1 (New), C 406.2.2 (New), C 406.2.3 (New), C 406.2.4 (New), C406.5. (New), C406.5, C 406.5.2 (New), C406.7 (New), C406.7, C406.7.1, C406.7.3 (New), C406.7.4 (New), C406.10 (New)

Proponent: jim edelson, representing New Buildings Institute (jim@newbuildings.org); Eric Makela, representing Northwest Energy Codes Group (ericm@newbuildings.org)

2018 International Energy Conservation Code

SECTION C406 ADDITIONAL EFFICIENCY PACKAGE OPTIONS REQUIREMENTS

Revise as follows:

C406.1 Requirements. ~~Buildings shall comply~~ New buildings shall achieve a total of 10 credits from Tables C406.1(1) through C406.1(5) where the table is selected based on the use group of the building. Where a building contains multiple use groups, credits from each use group shall be weighted by floor area of each group to determine the weighted average building credit. Credits may also be as calculated in accordance the relevant subsection of C406. Credits from the tables or calculation shall be achieved where a building complies with one or more of the following:

1. More efficient HVAC performance in accordance with Section C406.2.
2. Reduced lighting power in accordance with Section C406.3.
3. Enhanced lighting controls in accordance with Section C406.4.
4. On-site supply of renewable energy in accordance with Section C406.5.
5. Provision of a dedicated outdoor air system for certain HVAC equipment in accordance with Section C406.6.
6. High-efficiency service water heating in accordance with Section C406.7.
7. Enhanced envelope performance in accordance with Section C406.8.
8. Reduced air infiltration in accordance with Section C406.9
9. Extra daylit area with *daylight responsive controls* in accordance with Section C406.10

Add new text as follows:

Table C406.1(1)
Additional Energy Efficiency Credits for Group B Occupancies

Sub-section / Climate Zone:	1A	1B	2A	2B	3A	3B	3C	4A	4B	4C	5A	5B	5C	6 A	6 B	7	8
C406.2.1: 5% Heating Eff Imprv.	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1	NA	NA	1	1	NA	1
C406.2.2: 5% Cooling Eff Imprv.	6	6	5	5	4	4	3	3	3	2	2	2	1	2	2	2	1
C406.2.3: 10 % Heating Eff Imprv.	NA	NA	NA	NA	NA	NA	NA	1	NA	NA	2	1	1	2	2	NA	1
C406.2.4: 10 % Cooling Eff Imprv.	11	12	10	9	7	7	6	5	6	4	4	5	3	4	3	3	3
C406.3: Reduced Light Power	9	8	9	9	9	9	10	8	9	9	7	8	8	6	7	7	6
C406.4: Enh. Digital Light Ctrl	2	2	2	2	2	2	2	2	2	2	2	2	2	1	2	1	1
C406.5.1: On-site Renewable Egy.	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9
C406.6 : Dedicated OA Sys (DOAS)	4	4	4	4	4	3	2	5	3	2	5	3	2	7	4	5	3

C406.7.2: Recovered/Renew SWH	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
C406.7.3: Eff fossil fuel SWH	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
C406.7.4: Heat Pump SWH	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
C406.8: Enhanced Envelope Perf	1	4	2	4	4	3	NA	7	4	5	10	7	6	11	10	14	16
C406.9: Reduced Air Infiltration	2	1	1	2	4	1	NA	8	2	3	11	4	1	15	8	11	6
C406.10 Extra Daylit Area	7	6	7	7	6	7	8	6	7	6	5	6	6	5	6	5	4

Table C406.1(2)
Additional Energy Efficiency Credits for Group R and I Occupancies

Sub-section / Climate Zone:	1A	1B	2A	2B	3A	3B	3C	4A	4B	4C	5A	5B	5C	6 A	6 B	7	8
C406 .2.1: 5% Heating Eff Imprv.	NA	NA	NA	NA	1	NA	NA	1	NA	1	1	1	1	2	1	2	2
C406 .2.2: 5% Cooling Eff Imprv.	3	3	2	2	1	1	1	1	1	NA	1	1	NA	1	1	1	NA
C406 .2.3: 10 % Heating Eff Imprv.	NA	NA	NA	NA	1	NA	NA	1	1	1	2	2	1	3	2	3	4
C406 .2.4: 10 % Cooling Eff Imprv.	5	5	4	3	2	3	1	2	2	1	1	1	1	1	1	1	1
C406 .3: Reduced Light Power	2	2	2	2	2	2	3	2	2	2	2	2	2	2	2	2	2
C406 .4: Enh. Digital Light Ctrl	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
C406 .5.1: On-site Renewable Egy.	8	8	8	8	7	8	8	7	7	7	7	7	7	7	7	7	7
C406 .6 : Dedicated OA Sys (DOAS)	3	4	3	3	4	2	NA	6	3	4	8	5	5	10	7	11	12
C406 .7.2: Recovered/Renew SWH	10	9	11	10	13	12	15	14	14	15	14	14	16	14	15	15	15
C406 .7.3: Eff fossil fuel SWH	5	5	6	6	8	7	8	8	8	9	9	9	10	10	9	10	11
C406 .7.4: Heat Pump SWH	6	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
C406 .8: Enhanced Envelope Perf	3	6	3	5	4	4	1	4	3	3	4	5	3	5	4	6	6
C406 .9: Reduced Air Infiltration	6	5	3	11	6	4	NA	7	3	3	9	5	1	13	6	8	3
C406.10 Extra Daylit Area	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

Table C406.1(3)
Additional Energy Efficiency Credits for Group E Occupancies

Sub-section / Climate Zone:	1A	1B	2A	2B	3A	3B	3C	4A	4B	4C	5A	5B	5C	6 A	6 B	7	8
C406 .2.1: 5% Heating Eff Imprv.	NA	NA	NA	NA	1	1	1	1	1	2	1	2	1	2	2	3	4
C406 .2.2: 5% Cooling Eff Imprv.	4	4	3	3	2	2	2	2	1	1	1	1	NA	1	1	1	NA
C406 .2.3: 10 % Heating Eff Imprv.	NA	NA	NA	1	1	1	1	2	3	4	3	4	3	4	3	5	7
C406 .2.4: 10 % Cooling Eff Imprv.	7	8	7	6	5	4	3	4	3	1	2	2	1	2	2	2	1
C406 .3: Reduced Light Power	8	8	8	9	8	9	9	8	9	9	8	9	8	7	8	7	7
C406 .4: Enh. Digital Light Ctrl	2	2	2	2	2	2	2	2	2	2	2	3	2	2	2	2	1
C406 .5.1: On-site Renewable Egy.	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	5	5
C406 .6 : Dedicated OA Sys (DOAS)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
C406 .7.2: Recovered/Renew SWH ^a	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
C406 .7.3: Eff fossil fuel SWH ^a	NA	1	1	1	1	1	1	2	2	3	2	3	2	3	3	3	5
C406 .7.4: Heat Pump SWH ^a	NA	NA	NA	NA	NA	NA	NA	1	NA	NA	1	1	NA	1	1	1	1

C406 .8: Enhanced Envelope Perf	3	7	3	4	2	4	1	1	3	1	2	3	NA	4	3	6	9
C406 .9: Reduced Air Infiltration	1	1	1	2	NA	NA	NA	NA	NA	NA	1	NA	NA	4	1	4	3
C406.10 Extra Daylit Area	2	1	2	2	3	3	3	3	3	2	3	3	3	1	2	NA	NA

^a for schools with full service kitchens or showers

Table C406.1(4)
Additional Energy Efficiency Credits for Group M Occupancies

Sub-section / Climate Zone:	1A	1B	2A	2B	3A	3B	3C	4A	4B	4C	5A	5B	5C	6 A	6 B	7	8
C406 .2.1: 5% Heating Eff Imprv.	NA	NA	NA	NA	1	1	NA	1	1	2	2	2	2	3	2	3	4
C406 .2.2: 5% Cooling Eff Imprv.	5	6	4	4	3	3	1	2	2	1	1	2	NA	1	1	1	NA
C406 .2.3: 10 % Heating Eff Imprv.	NA	NA	NA	1	1	1	1	2	2	4	3	4	5	5	3	6	8
C406 .2.4: 10 % Cooling Eff Imprv.	9	12	9	8	6	6	3	4	4	1	2	3	NA	2	2	2	1
C406 .3: Reduced Light Power	13	13	15	14	16	14	17	15	15	14	12	14	14	16	16	14	12
C406 .4: Enh. Digital Light Ctrl	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
C406 .5.1: On-site Renewable Egy.	8	8	8	8	8	8	8	8	8	7	7	7	7	7	7	7	6
C406 .6 : Dedicated OA Sys (DOAS)	3	4	3	3	3	3	1	3	2	2	2	3	2	4	3	4	4
C406 .7.2: Recovered/Renew SWH	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
C406 .7.3: Eff fossil fuel SWH	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
C406 .7.4: Heat Pump SWH	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
C406 .8: Enhanced Envelope Perf	4	6	3	4	3	3	1	6	4	4	4	5	4	6	5	8	9
C406 .9: Reduced Air Infiltration	1	1	1	2	1	1	NA	3	1	1	3	2	1	7	3	6	3
C406.10 Extra Daylit Area	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

Table C406.1(5)
Additional Energy Efficiency Credits for Other^a Occupancies

Sub-section / Climate Zone:	1A	1B	2A	2B	3A	3B	3C	4A	4B	4C	5A	5B	5C	6 A	6 B	7	8
C406 .2.1: 5% Heating Eff Imprv.	NA	NA	NA	NA	1	1	1	1	1	2	1	2	1	2	2	3	3
C406 .2.2: 5% Cooling Eff Imprv.	5	5	4	4	3	3	2	2	2	1	1	2	1	1	1	1	1
C406 .2.3: 10 % Heating Eff Imprv.	NA	NA	NA	1	1	1	1	2	2	3	3	3	3	4	3	5	5
C406 .2.4: 10 % Cooling Eff Imprv.	8	9	8	7	5	5	3	4	4	2	2	3	2	2	2	2	2
C406 .3: Reduced Light Power	8	8	9	9	9	9	10	8	9	9	7	8	8	8	8	8	7
C406 .4: Enh. Digital Light Ctrl	2	2	2	2	2	2	2	2	2	2	2	3	2	2	2	2	1
C406 .5.1: On-site Renewable Egy.	8	8	8	8	8	8	8	8	8	7	7	7	7	7	7	7	7
C406 .6 : Dedicated OA Sys (DOAS)	3	4	3	3	4	3	2	5	3	3	5	4	3	7	5	7	6
C406 .7.2: Recovered/Renew SWH ^b	10	9	11	10	13	12	15	14	14	15	14	14	16	14	15	15	15
C406 .7.3: Eff fossil fuel SWH ^b	5	5	6	6	8	7	8	8	8	9	9	9	10	10	9	10	11
C406 .7.4: Heat Pump SWH ^b	6	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
C406 .8: Enhanced Envelope Perf	3	6	3	4	3	4	1	5	4	3	5	5	4	7	6	9	10
C406 .9: Reduced Air Infiltration	3	2	2	4	4	2	NA	6	2	2	6	4	1	10	5	7	4

C406.10 Extra Daylit Area	3	2	3	3	3	3	4	3	3	3	3	3	2	3	2	NA
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a Other occupancy groups include all Groups except for Groups B, R, I, E, and M.

b for occupancy groups listed in C406 .7.1.

Revise as follows:

C406.1.1 Tenant spaces. Tenant spaces shall comply with sufficient options from Tables C406.1(1) through C406.1(5) to achieve a minimum number of 5 credits, where credits are selected from Section C406.2, C406.3, C406.4, C406.6 or C406.7. Alternatively, tenant spaces shall comply with Section C406.5 where the entire building is in compliance, C406.7, or C406.10. Where the entire building complies using credits from Section C406.5, C406.8 or C406.9, tenant spaces within the building shall be deemed to comply this section.

Exception: Previously occupied tenant spaces that comply with this code in accordance with Section C501.

C406.2 More efficient HVAC equipment performance. Equipment shall exceed the minimum efficiency requirements listed in Tables C403.3.2(1) through C403.3.2(7) ~~by 10 percent, in addition to the requirements of Section C403. Where multiple performance requirements are provided, the equipment shall exceed all requirements by 10 percent.~~ 9). Variable refrigerant flow systems shall exceed listed in the energy efficiency provisions of ANSI/ASHRAE/IESNA 90.1 by 10 percent. 90.1. in accordance with Sections C406 .2.1, C406 .2.2, C406 .2.3 or C406 .2.4. Equipment shall also meet applicable requirements of Section C403. Energy efficiency credits for heating shall be selected from C406 .2.1 or C406.2.3 and energy efficiency credits for cooling shall be selected from C406.2.2 or C406.2.4. Selected credits shall include a heating or cooling energy efficiency credit or both. Equipment not listed in Tables C403.3.2(1) through C403.3.2(7) ~~9) and Variable refrigerant flow systems~~ not listed in the energy efficiency provisions of ANSI/ASHRAE/IES 90 .1 shall be limited to 10 percent of the total building system capacity. capacity for heating equipment where selecting C406.2.1 or C406.2.3 and cooling equipment where selecting C406.2.2 or C406.2.4. .

Add new text as follows:

C 406.2.1 Five percent heating efficiency improvement. Equipment shall exceed the minimum heating efficiency requirements by 5 percent.

C 406.2.2 Five percent cooling efficiency improvement Equipment shall exceed the minimum cooling and heat rejection efficiency requirements by 5 percent. Where multiple cooling performance requirements are provided, the equipment shall exceed the annual energy requirement, including IEER, SEER, and IPLV.

C 406.2.3 Ten percent heating efficiency improvement Equipment shall exceed the minimum heating efficiency requirements by 10 percent.

C 406.2.4 Ten percent cooling efficiency improvement Equipment shall exceed the minimum cooling and heat rejection efficiency requirements by 10 percent. Where multiple cooling performance requirements are provided, the equipment shall exceed the annual energy requirement, including IEER, SEER, and IPLV.

C406.5. On-site renewable Buildings shall comply with Section C406 .5.1 or C406 .5.2.

Revise as follows:

C C406.5 C406.5.1 On-site-Basic renewable energy- credit The total minimum ratings of on-site renewable energy systems not including systems used for credits under Section C406.7.2 shall be one of the following:

1. Not less than ~~1.71-0.86~~ Btu/h per square foot (~~5.4-2.7~~ W/m²) or ~~0.50-0.25~~ watts per square foot

(~~5.4-2.7~~ W/m²) of conditioned floor area.

2. Not less than ~~3-2~~ percent of the annual energy used within the building for building mechanical and service water heating equipment and lighting regulated in Chapter 4.

Add new text as follows:

C 406.5.2 Enhanced Renewable Credits. Where the total minimum ratings of on-site renewable energy systems exceeds the rating in C406 .5.1(1), additional energy efficiency credits shall be determined based on Equation 4-13, rounded to the nearest whole number.

$$AEEC_{RRa} = AEEC_{2.5} \times RRa / RR_1 \text{ (Equation 4-13)}$$

Where:

$AEEC_{RRa}$ = C406 .5.2 additional energy efficiency credits

RRa = actual total minimum ratings of *on-site renewable energy* systems in Btu/h, watts per square foot or W/m²)

$RR1$ = minimum ratings of *on-site renewable energy* systems required by C406 .5.1(1) in Btu/h, watts per square foot or W/m²)

$AEEC_{2.5}$ = C406 .5.1 credits from Tables C406 .1(1) through C406 .1(5)

C406.7 Reduced energy use in service water heating. Buildings shall comply with Sections C406.7.1 and either C406 .7.2, C406 .7.3 or C406 .7.4.

Revise as follows:

~~C406.7 C406.7.1 Reduced energy use in service water heating.~~ **Building Type** Buildings shall be of the following types to use this compliance method To qualify for this credit, the building shall contain one of the following use groups and the additional energy efficiency credit shall be prorated by conditioned floor area of the portion of the building comprised of the following use groups:

1. *Group R-1: Boarding houses, hotels or motels.*
2. *Group I-2: Hospitals, psychiatric hospitals and nursing homes.*
3. *Group A-2: Restaurants and banquet halls or buildings containing food preparation areas.*
4. *Group F: Laundries.*
5. *Group R-2.*
6. *Group A-3: Health clubs and spas.*
7. *Group E: Schools with full-service kitchens or locker rooms with showers.*
8. Buildings showing a service hot water load of 10 percent or more of total building energy loads, as shown with an energy analysis as described in Section C407.

~~C406.7.1 C406.7.2 Load fraction.~~ **Recovered or renewable water heating** The building service water-heating system shall have one or more of the following that are sized to provide not less than ~~60-30~~ percent of the building's annual hot water requirements, or sized to provide ~~100-70~~ percent of the building's annual hot water requirements if the building ~~shall otherwise be required to~~ comply with Section C403.9.5:

1. Waste heat recovery from service hot water, heat-recovery chillers, building equipment, or process equipment.
2. *On-site renewable energy* water-heating systems.

Add new text as follows:

C406.7.3 Efficient fossil fuel water heater. The combined input-capacity-weighted-average equipment rating of all fossil fuel water heating equipment in the building shall be not less than 95% Et or 0.95 EF. This option shall receive only half the listed credits for buildings required to comply with C404.2.1.

C406.7.4 Heat pump water heater. Where electric resistance water heaters are allowed, all service hot water system heating requirements shall be met using heat pump technology with a combined input-capacity-weighted-average EF of 3.0. Air-source heat pump water heaters shall not draw conditioned air from within the building, except exhaust air that would otherwise be exhausted to the exterior.

C406.10 Extra Daylit Area Building shall not use the energy efficiency credits for Section C406.7, enhanced lighting control, and shall provide continuous dimming daylight responsive controls for 150 percent of the area required to have daylight responsive controls in toplit zones and sidelit zones in Section C405.2.3 or as required by Section C402.4.1.1. Toplit and sidelit zones as defined in Sections C405.2.3.2 and C405.2.3.3 shall be controlled separately from adjacent daylight zones.

Reason:

C406 Credits for Added Daylighting Area

This proposal builds on top of a proposal that assigns energy efficiency credits to each option in Section C406 (CE218-19). For clarity, that entire base proposal is included here with additional provisions and table row additions that provide an additional energy efficiency credit option when extra daylit area included in the building. As part of the comprehensive analysis of C406 measures that is listed in the bibliography, the relative energy cost savings for each measure was determined. Then points or credits were assigned to each measure by climate zone and building type based on one point per 0.25% building cost savings.

This proposal allows credit for increased daylighting area in Section C406 where extra efficiency options are required and includes the following:

- Adds provisions to increase the daylit area to 150% of prescriptively required area.
- Add rows with appropriate credits to the 5 occupancy group tables for this provision.

The current daylighting requirements apply only to what are considered primary daylit zones. These are toplit and sidelit zones as defined in Sections C405.2.3.2 and C405.2.3.3. This measure extends the primary daylit area by adding 50% more daylit area.

Expanding the daylit control area (Section C406.10) saves energy by reducing lighting power when daylighting is available in these areas. This measure provides more flexibility to building designers when it is added to the energy efficiency credit choices. It specifically provides an expansion in the daylit area, which allows lighting to be reduced in a larger portion of the building with daylight responsive controls. The proposal requires separate control of the luminaire light levels in primary and secondary daylit areas.

Bibliography: Hart, R., R. Nambiar, M. Tyler, M., Y. Xie, and J. Zhang. "Relative Credits for Extra Efficiency Measures: Technical Brief." Pacific Northwest National Laboratory (PNNL), Richland, WA (US), January 2019.

Cost Impact: The code change proposal will not increase or decrease the cost of construction. The current proposal does not require more investment, but rather expands existing options permitted under the 2018 IECC. The intention is to identify additional options to increase flexibility and more effectively utilize new technologies and construction practices. There is not expected to be an increased cost, as this simply increases the options for C406 beyond what is included in current code. In some cases, costs may be reduced, as the outlined approach provides partial credit for selected items as well as credit for items that may have previously been included in the building design without credit. Costs, and cost effectiveness, are not evaluated for individual measures due to the vast number of potential combinations amongst building types, climates, and selected options. Actual costs will vary based on the items selected by the building designer—architects, engineers, and other involved trades—based on the needs and goals of the individual project.

Proposal # 5107

CE235-19

CE236-19

IECC: C406.1, C406.1.1, C406.10 (New)

Proponent: Mark Lyles, representing Northwest Energy Codes Group (markl@newbuildings.org)

2018 International Energy Conservation Code

C406.1 Requirements. Buildings shall comply with one or more of the following:

1. More efficient HVAC performance in accordance with Section C406.2.
2. Reduced lighting power in accordance with Section C406.3.
3. Enhanced lighting controls in accordance with Section C406.4.
4. On-site supply of renewable energy in accordance with Section C406.5.
5. Provision of a dedicated outdoor air system for certain HVAC equipment in accordance with Section C406.6.
6. High-efficiency service water heating in accordance with Section C406.7.
7. Enhanced envelope performance in accordance with Section C406.8.
8. Reduced air infiltration in accordance with Section C406.9.
9. Extra Daylit Area with Daylight Responsive Controls in accordance with Section C406.10.

C406.1.1 Tenant spaces. Tenant spaces shall comply with Section C406.2, C406.3, C406.4, C406.6 or ~~C406.7. Alternatively, C406.7 or C406.10.~~ Where the entire building complies using Section C406.5, C406.8 or C406.9, tenant spaces within the building shall be deemed to comply with Section C406.5 where the entire building is in compliance; this Section.

Exception: Previously occupied tenant spaces that comply with this code in accordance with Section C501.

Add new text as follows:

C406.10 Extra Daylit Area Building shall not use the energy efficiency credits for Section C406.7, enhanced lighting control, and shall provide continuous dimming daylight responsive controls for 150 percent of the area required to have daylight responsive controls in toplit zones and sidelit zones in Section C405.2.3 or as required by Section C402.4.1.1. Toplit and sidelit zones as defined in Sections C405.2.3.2 and C405.2.3.3 shall be controlled separately from adjacent daylight zones.

Reason:

C406 add Added Daylighting Area

This proposal adds a new option in Section C406, increasing flexibility in meeting this additional efficiency requirement. This proposal allows selection of a provision with increased daylighting area in Section C406 where extra efficiency options are required and includes the following:

- Adds provisions to increase the daylit area to 150% of prescriptively required area.

The current daylighting requirements apply only to what are considered primary daylit zones. These are toplit and sidelit zones as defined in Sections C405.2.3.2 and C405.2.3.3. This measure extends the primary daylit area by adding 50% more daylit area.

Expanding the daylit control area (Section C406.10) saves energy by reducing lighting power when daylighting is available in these areas. This measure provides more flexibility to building designers

when it is added to the energy efficiency credit choices. It specifically provides an expansion in the daylit area, which allows lighting to be reduced in a larger portion of the building with daylight responsive controls. The proposal requires separate control of the luminaire light levels in primary and secondary daylit areas.

Bibliography: *Savings for this measure is illustrated here:*

Hart, R., R. Nambiar, M. Tyler, M., Y. Xie, and J. Zhang. "Relative Credits for Extra Efficiency Measures: Technical Brief." Pacific Northwest National Laboratory (PNNL), Richland, WA (US), January 2019.

https://www.pnnl.gov/main/publications/external/technical_reports/PNNL-28370Rev.1.pdf.

Cost Impact: The code change proposal will not increase or decrease the cost of construction. The current proposal does not require more investment, but rather expands existing options permitted under section C406 of the 2018 IECC. The intention is to identify additional options to increase flexibility and more effectively utilize new technologies and construction practices. There is not expected to be an increased cost, as this simply increases the options for C406 beyond what is included in current code. Actual costs will vary based on the items selected by the building designer—architects, engineers, and other involved trades—based on the needs and goals of the individual project.

Proposal # 5766

CE236-19

CE237-19

IECC: C406.1, C406.10 (New), C406.10.1 (New), C406.10.2 (New), TABLE 406.10.2 (New), C406.10.3 (New), C406.10.4 (New), C406.10.5 (New)

Proponent: Harold Jepsen, representing National Electrical Manufacturers Association
(harold.jepsen@legrand.us)

2018 International Energy Conservation Code

Revise as follows:

C406.1 Requirements. Buildings shall comply with one or more of the following:

1. More efficient HVAC performance in accordance with Section C406.2.
2. Reduced lighting power in accordance with Section C406.3.
3. Enhanced lighting controls in accordance with Section C406.4.
4. On-site supply of renewable energy in accordance with Section C406.5.
5. Provision of a dedicated outdoor air system for certain HVAC equipment in accordance with Section C406.6.
6. High-efficiency service water heating in accordance with Section C406.7.
7. Enhanced envelope performance in accordance with Section C406.8.
8. Reduced air infiltration in accordance with Section C406.9
9. Include an energy monitoring system in accordance with C406.10

Add new text as follows:

C406.10 Energy Monitoring Buildings shall comply with Section C406.10.1 through C406.10.5. Buildings shall be equipped to measure, monitor, record and report energy consumption data for each end-use category required by Section C406.10.2.

C406.10.1 Electrical energy metering. For electrical energy, including all electrical energy supplied to the building and its associated site, including but not limited to site lighting, parking, recreational facilities, and other areas that serve the building and its occupants, meters or other measurement devices shall be provided to collect energy consumption data for each end-use category required by Section C406.10.2.

C406.10.2 End-use metering categories. Meters or other approved measurement devices shall be provided to collect energy use data for each end-use category listed in Table 406.10.2. These meters shall have the capability to collect energy consumption data for the whole building or for each separately metered portion of the building. Where multiple meters are used to measure any end-use category, the data acquisition system shall total all of the energy used by that category. Not more than 5 percent of the measured load for each of the end-use categories listed in Table 406.10.2 is permitted to be from a load not within the category.

Exceptions:

1. HVAC and water heating equipment serving only an individual dwelling unit does not require end-use metering.
2. End-use metering is not required for fire pumps, stairwell pressurization fans or any system that operates only during testing or emergency.

TABLE 406.10.2 ENERGY USE CATEGORIES

<u>LOAD CATEGORY</u>	<u>DESCRIPTION OF ENERGY USE</u>
<u>Total HVAC system</u>	<u>Heating, cooling and ventilation including, but not limited to fans, pumps, boilers, chillers and water heating. Energy used by 120 volt equipment, or by 208/120 volt equipment that is located in a building where the main service is 480/277 volt power, is permitted to be excluded from Total HVAC system energy use.</u>
<u>Interior lighting</u>	<u>Lighting systems located within the <i>building</i>.</u>
<u>Exterior lighting</u>	<u>Lighting systems located on the building site but not within the building.</u>
<u>Plug loads</u>	<u>Devices, appliances and equipment connected to convenience receptacle outlets.</u>
<u>Process loads</u>	<u>Any single load that is not included in a HVAC, lighting, or plug load category and that exceeds 5 percent of the peak connected load of the whole building including, but not limited to data centers, manufacturing equipment and commercial kitchens.</u>
<u>Building operations and other miscellaneous loads</u>	<u>The remaining loads not included elsewhere in this table including, but not limited to, vertical transportation systems, automatic doors,</u>

C406.10.3 Meters. Meters or other measurement devices required by this Section shall be configured to automatically communicate energy consumption data to the data acquisition system required by Section C406.10.4. Source meters shall be allowed to be any digital-type meter. Lighting, HVAC, or other building systems that can monitor their energy consumption shall be permitted instead of meters. Current sensors shall be permitted, provided that they have a tested accuracy of +/-2 percent. Required metering systems and equipment shall have the capability to provide at least hourly data that is fully integrated into the data acquisition system and graphical energy report in accordance with Sections 406.10.4 and C406.10.5.

C406.10.4 Data acquisition system. A data acquisition system shall have the capability to store the data from the required meters and other sensing devices for a minimum of 36 months. The data acquisition system shall

have the capability to store real-time energy consumption data and provide hourly, daily, monthly, and yearly logged data for each end-use category required by Section C406.10.2.

C406.10.5 Graphical energy report. A permanent and readily accessible reporting mechanism shall be provided in the building that is accessible by building operation and management personnel. The reporting mechanism shall have the capability to graphically provide the energy consumption for each end-use category required by Section C406.10.2 at least every hour, day, month and year for the previous 36 months.

Reason: The investment made for the infrastructure of a building in order to comply with the IECC is significant. The assumption that is currently made upon commissioning a facility is that energy efficiency measures will not degrade, or go out of calibration, over time and their energy consumption will not increase as time passes from the time they were commissioned. Such an assumption is completely inaccurate and any payback assumed for energy efficient infrastructure investments will be lengthened, thereby reducing the ROI and increasing the payback period. The only means to retain the energy performance of a building is to continuously monitor energy consumption levels of various energy consuming systems and compare them to previous levels. Monitoring sub-systems provides key indications when changes have been made or systems are not operating to specification, which increases energy consumption. Examples include, but are not limited to:

1. Increased energy consumption in HVAC system loads will point to failures in motors, drive systems, bearings, etc.
2. Degrading building envelope
3. Configuration changes to the building that may drive increased energy consumption.
4. Increase of energy consumption from lighting loads may indicate changes in arrangement of the office space that resulted in reduced lighting loads may indicate change in arrangement of the office space that resulted in reduced lighting driving the installation of more lighting above permitted energy code levels, failure of occupant sensors, inappropriate lighting schedules, lamps that need to be replaced or cleaned, etc.
5. Monitoring plug loads will indicate then computer equipment is left on during non-working hours and use of space heaters that compromise the efficiency of the facility due to set points on the HVAC system.

The requirements in this proposal save energy by continually monitoring and reporting actionable energy consumption data to building owners and operators. For large buildings, this data is further broken out by the major sub-systems (HVAC, lighting, process loads, and plug loads). There are well documented studies that demonstrate the energy savings from metering and monitoring systems. Several state energy codes have recognized the benefits and require energy monitoring to support a continual high level of performance from the energy efficient investment.

Cost Impact: The code change proposal will not increase or decrease the cost of construction. The code change proposal “will” increase the cost of construction because it will require additional hardware, software and labor during installation. Providing specific cost would violate antitrust laws, however the following link to a report provided by the GSA demonstrates an example of cost and savings:

https://www.gsa.gov/cdnstatic/Energy_Submetering_Finance_Paper_Knetwork_2012_11_269%28508%29.pdf

Proposal # 4428

CE237-19

CE238-19

IECC: C202 (New), C406.1, C406.10(New), C406.10.1(New)

Proponent: Sharon Bonesteel, representing Salt River Project (sharon.bonesteel@srpnet.com); Steven Rosenstock, representing Edison Electric Institute (srosenstock@eei.org)

2018 International Energy Conservation Code

SECTION C202 GENERAL DEFINITIONS

Add new definition as follows:

ELECTRICAL ENERGY STORAGE SYSTEM (EESS). A system used to provide standby or emergency power, an uninterruptable power supply, load shedding, load sharing or similar capabilities in accordance with Section 1206 of the *International Fire Code*.

LOAD. A portion of a system that consumes electric energy. The total electrical *load* of a building is the sum of all electricity consuming appliances, lights and systems, necessary for a building to function as designed.

ON-PEAK. The time of use during which the cost per kiloWatt-hour (kWh) is the highest and when the maximum generation resources are required to supply electricity to the customer.

OFF-PEAK. The time of use during which the cost per kiloWatt-hour (kWh) is the lowest and when generation resources are being underutilized.

ENERGY MANAGEMENT SYSTEM. An electronic system that protects stationary storage batteries from operating outside of their safe operating parameters, and generates an alarm and trouble signal for off normal conditions.

SECTION C406 ADDITIONAL EFFICIENCY PACKAGE OPTIONS

Revise as follows:

C406.1 Requirements. Buildings shall comply with one or more of the following:

1. More efficient HVAC performance in accordance with Section C406.2.
2. Reduced lighting power in accordance with Section C406.3.
3. Enhanced lighting controls in accordance with Section C406.4.
4. On-site supply of renewable energy in accordance with Section C406.5.
5. Provision of a dedicated outdoor air system for certain HVAC equipment in accordance with Section C406.6.
6. High-efficiency service water heating in accordance with Section C406.7.
7. Enhanced envelope performance in accordance with Section C406.8.
8. Reduced air infiltration in accordance with Section C406.9.
9. Provision of an electrical energy storage system (EESS) controlled via an energy management system that shall be programed to shift a portion of the building load from on-peak to off-peak, in accordance with Section C406.10.

Add new text as follows:

C406.10 Electrical energy storage system (EESS). EESS shall be controlled by an energy management system that is programmed to shift the load from on-peak to off-peak.

C406.10.1 System storage capabilities. The system shall be capable of storing the following:

1. Not less than 0.05 watts per square foot (0.54 W/m²) of conditioned floor area.
2. Not less than 10 percent of the energy used within the building for building mechanical and service water heating equipment and lighting regulated in Chapter 4.

Reason: The conservation of energy and its related cost are the foundation of the IECC. Demand charges make a large impact on a businesses' utility bill. The inclusion of energy storage will allow these businesses to shift that load from on-peak (most expensive per kw) to off-peak (least expensive per kw) and thus reduce their demand charges. Utilizing off-peak energy to charge up the energy storage for use during on-peak times results in efficient use of the energy generation facilities available to the business.

Definitions that are common in the utility world are not defined in the codes. Utilities clearly indicate on their websites the on-peak and off-peak hours, as well as the cost difference between a kw based upon the time of use. Referencing definitions for EESS from the 2018 IFC and Load calculations clearly being defined in 2017 NFPA Art.220.40, facilitates consistency between codes.

Cost Impact: The code change proposal will not increase or decrease the cost of construction. This code change provides another option within Section C406, allowing businesses to utilize their energy efficiently. The shift of a load from on-peak period to off-peak is an important aspect of the effective use of energy. This code change also provides definitions that are common in the utility world and are necessary for the inclusion of energy storage in the effective use of energy. Referencing definitions in the IFC and the NEC facilitate consistency between codes.

Proposal # 5032

CE238-19

CE239-19

IECC: C202, C406.1, C406.10 (New)

Proponent: Marilyn Williams, representing National Electrical Manufacturers Association
(mar_williams@nema.org)

2018 International Energy Conservation Code

Add new definition as follows:

FAULT DETECTION AND DIAGNOSTICS (FDD) SYSTEM. A software platform that utilizes building analytic algorithms to convert data provided by sensors and devices to automatically identify faults in building systems and provide a prioritized list of actionable resolutions to those faults based on cost or energy avoidance, comfort and maintenance impact.

Revise as follows:

C406.1 Requirements. Buildings shall comply with one or more of the following:

1. More efficient HVAC performance in accordance with Section C406.2.
2. Reduced lighting power in accordance with Section C406.3.
3. Enhanced lighting controls in accordance with Section C406.4.
4. On-site supply of renewable energy in accordance with Section C406.5.
5. Provision of a dedicated outdoor air system for certain HVAC equipment in accordance with Section C406.6.
6. High-efficiency service water heating in accordance with Section C406.7.
7. Enhanced envelope performance in accordance with Section C406.8.
8. Reduced air infiltration in accordance with Section C406.9
9. Include a fault detection and diagnostics (FDD) system in accordance with Section C406.10.

Add new text as follows:

C406.10 Fault detection and diagnostics system. A fault detection and diagnostics system shall be installed to monitor the HVAC system's performance and automatically identify faults. The system shall:

1. Include permanently installed sensors and devices to monitor the HVAC system's performance;
2. Sample the HVAC system performance at least once per 15 minutes;
3. Automatically identify and report HVAC system faults;
4. Automatically notify authorized personnel of identified HVAC system faults;
5. Automatically provide prioritized recommendations for repair of identified faults based on analysis of data collected from the sampling of the HVAC system performance; and
6. Be capable of transmitting the prioritized fault repair recommendations to remotely located authorized personnel.

Reason: Energy efficiency of a new building's HVAC system will degrade over time caused by poorly maintained, failing and improperly controlled equipment. The proposed FDD requirement will reduce that degradation by detecting HVAC system faults and notifying building operators so that actions may be taken to reduce energy consumption of the building. Additionally, FDD systems are being utilized to drive operational efficiency, make better use of maintenance personnel, and resolve comfort issues.

Cost Impact: The code change proposal will not increase or decrease the cost of construction. If the alternative being proposed to the list of additional energy efficiency measures by this proposal is selected, it "will" increase the cost of construction because it will require additional hardware, software and labor during

installation. Providing specific cost would violate antitrust laws, however a published example of cost and savings is provided from the following link <https://ecobuilding.schneider-electric.com/documents/10807/217223/Lab+Project+Building+Analytics+Case+Study/a6d8b9b6-7fdd-4e87-a90b-c98ece595a25>: Setup/install cost - \$23,190, Annual maintenance cost - \$35,407, and Annual savings - \$286,000.

Proposal # 4438

CE239-19

CE240-19

IECC: SECTION C406, C406.1, Table C406.1(1) (New), Table C406.1(2) (New), Table C406.1(3) (New), Table C406.1(4) (New), Table C406.1(5) (New), C406.1.1, C406.2, C406.2.1 (New), C406.2.2 (New), C406.2.3 (New), C406.2.4 (New), C406.5, C406.5.2 (New), C406.7, C406.7.1, C406.7.3 (New), C406.7.4 (New), C406.10 (New), Table C406.10(1) (New), Table C406.10(2) (New), Table C406.10(3) (New), Table C406.10(4) (New), ASTM Chapter 06 (New)

Proponent: Nicholas O'Neil, NW Energy Codes Group, representing NW Energy Codes Group (noneil@energy350.com); Mark Lyles, representing Northwest Energy Codes Group (markl@newbuildings.org)

2018 International Energy Conservation Code

SECTION C406 ADDITIONAL EFFICIENCY PACKAGE OPTIONS REQUIREMENTS

C406.1 Requirements- Additional energy efficiency requirements Buildings shall comply New buildings shall achieve a total of 10 credits from Tables C406.1(1) through C406.1(5) where the table is selected based on the use group of the building. Where a building contains multiple use groups, credits from each use group shall be weighted by floor area of each group to determine the weighted average building credit. Credits may also be as calculated in accordance the relevant subsection of C406. Credits from the tables or calculation shall be achieved where a building complies with one or more of the following:

1. More efficient HVAC performance in accordance with Section C406.2.
2. Reduced lighting power in accordance with Section C406.3.
3. Enhanced lighting controls in accordance with Section C406.4.
4. On-site supply of renewable energy in accordance with Section C406.5.
5. Provision of a dedicated outdoor air system for certain HVAC equipment in accordance with Section C406.6.
6. High-efficiency service water heating in accordance with Section C406.7.
7. Enhanced envelope performance in accordance with Section C406.8.
8. Reduced air infiltration in accordance with Section C406.9
9. Efficient Kitchen Equipment in accordance with Section C406.10.

Add new text as follows:

Table C406.1(1)
Additional Energy Efficiency Credits for Group B Occupancies

Sub-section / Climate Zone:	1A	1B	2A	2B	3A	3B	3C	4A	4B	4C	5A	5B	5C	6 A	6 B	7	8
C406.2.1: 5% Heating Eff Imprv.	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1	NA	NA	1	1	NA	1
C406.2.2: 5% Cooling Eff Imprv.	6	6	5	5	4	4	3	3	3	2	2	2	1	2	2	2	1
C406.2.3: 10 % Heating Eff Imprv.	NA	NA	NA	NA	NA	NA	NA	1	NA	NA	2	1	1	2	2	NA	1
C406 .2.4: 10 % Cooling Eff Imprv.	11	12	10	9	7	7	6	5	6	4	4	5	3	4	3	3	3
C406.3: Reduced Light Power	9	8	9	9	9	9	10	8	9	9	7	8	8	6	7	7	6
C406.4: Enh. Digital Light Ctrl	2	2	2	2	2	2	2	2	2	2	2	2	2	1	2	1	1
C406.5.1: On-site Renewable Egy.	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9
C406.6 : Dedicated OA Sys (DOAS)	4	4	4	4	4	3	2	5	3	2	5	3	2	7	4	5	3
C406.7.2: Recovered/Renew SWH	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

C406.7.3: Eff fossil fuel SWH	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
C406.7.4: Heat Pump SWH	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
C406.8: Enhanced Envelope Perf	1	4	2	4	4	3	NA	7	4	5	10	7	6	11	10	14	16
C406.9: Reduced Air Infiltration	2	1	1	2	4	1	NA	8	2	3	11	4	1	15	8	11	6

Table C406.1(2)
Additional Energy Efficiency Credits for Group R and I Occupancies

Sub-section / Climate Zone:	1A	1B	2A	2B	3A	3B	3C	4A	4B	4C	5A	5B	5C	6 A	6 B	7	8
C406 .2.1: 5% Heating Eff Imprv.	NA	NA	NA	NA	1	NA	NA	1	NA	1	1	1	1	2	1	2	2
C406 .2.2: 5% Cooling Eff Imprv.	3	3	2	2	1	1	1	1	1	NA	1	1	NA	1	1	1	NA
C406 .2.3: 10 % Heating Eff Imprv.	NA	NA	NA	NA	1	NA	NA	1	1	1	2	2	1	3	2	3	4
C406 .2.4: 10 % Cooling Eff Imprv.	5	5	4	3	2	3	1	2	2	1	1	1	1	1	1	1	1
C406 .3: Reduced Light Power	2	2	2	2	2	2	3	2	2	2	2	2	2	2	2	2	2
C406 .4: Enh. Digital Light Ctrl	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
C406 .5.1: On-site Renewable Egy.	8	8	8	8	7	8	8	7	7	7	7	7	7	7	7	7	7
C406 .6 : Dedicated OA Sys (DOAS)	3	4	3	3	4	2	NA	6	3	4	8	5	5	10	7	11	12
C406 .7.2: Recovered/Renew SWH	10	9	11	10	13	12	15	14	14	15	14	14	16	14	15	15	15
C406 .7.3: Eff fossil fuel SWH	5	5	6	6	8	7	8	8	8	9	9	9	10	10	9	10	11
C406 .7.4: Heat Pump SWH	6	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
C406 .8: Enhanced Envelope Perf	3	6	3	5	4	4	1	4	3	3	4	5	3	5	4	6	6
C406 .9: Reduced Air Infiltration	6	5	3	11	6	4	NA	7	3	3	9	5	1	13	6	8	3

Table C406.1(3)
Additional Energy Efficiency Credits for Group E Occupancies

Sub-section / Climate Zone:	1A	1B	2A	2B	3A	3B	3C	4A	4B	4C	5A	5B	5C	6 A	6 B	7	8
C406 .2.1: 5% Heating Eff Imprv.	NA	NA	NA	NA	1	1	1	1	1	2	1	2	1	2	2	3	4
C406 .2.2: 5% Cooling Eff Imprv.	4	4	3	3	2	2	2	2	1	1	1	1	NA	1	1	1	NA
C406 .2.3: 10 % Heating Eff Imprv.	NA	NA	NA	1	1	1	1	2	3	4	3	4	3	4	3	5	7
C406 .2.4: 10 % Cooling Eff Imprv.	7	8	7	6	5	4	3	4	3	1	2	2	1	2	2	2	1
C406 .3: Reduced Light Power	8	8	8	9	8	9	9	8	9	9	8	9	8	7	8	7	7
C406 .4: Enh. Digital Light Ctrl	2	2	2	2	2	2	2	2	2	2	2	3	2	2	2	2	1
C406 .5.1: On-site Renewable Egy.	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	5	5
C406 .6 : Dedicated OA Sys (DOAS)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
C406 .7.2: Recovered/Renew SWH ^a	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
C406 .7.3: Eff fossil fuel SWH ^a	NA	1	1	1	1	1	1	2	2	3	2	3	2	3	3	3	5
C406 .7.4: Heat Pump SWH ^a	NA	NA	NA	NA	NA	NA	NA	1	NA	NA	1	1	NA	1	1	1	1
C406 .8: Enhanced Envelope Perf	3	7	3	4	2	4	1	1	3	1	2	3	NA	4	3	6	9
C406 .9: Reduced Air Infiltration	1	1	1	2	NA	NA	NA	NA	NA	NA	1	NA	NA	4	1	4	3

^a for schools with full service kitchens or showers

Table C406.1(4)
Additional Energy Efficiency Credits for Group M Occupancies

Sub-section / Climate Zone:	1A	1B	2A	2B	3A	3B	3C	4A	4B	4C	5A	5B	5C	6 A	6 B	7	8
C406 .2.1: 5% Heating Eff Imprv.	NA	NA	NA	NA	1	1	NA	1	1	2	2	2	2	3	2	3	4
C406 .2.2: 5% Cooling Eff Imprv.	5	6	4	4	3	3	1	2	2	1	1	2	NA	1	1	1	NA
C406 .2.3: 10 % Heating Eff Imprv.	NA	NA	NA	1	1	1	1	2	2	4	3	4	5	5	3	6	8
C406 .2.4: 10 % Cooling Eff Imprv.	9	12	9	8	6	6	3	4	4	1	2	3	NA	2	2	2	1
C406 .3: Reduced Light Power	13	13	15	14	16	14	17	15	15	14	12	14	14	16	16	14	12
C406 .4: Enh. Digital Light Ctrl	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
C406 .5.1: On-site Renewable Egy.	8	8	8	8	8	8	8	8	8	7	7	7	7	7	7	7	6
C406 .6 : Dedicated OA Sys (DOAS)	3	4	3	3	3	3	1	3	2	2	2	3	2	4	3	4	4
C406 .7.2: Recovered/Renew SWH	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
C406 .7.3: Eff fossil fuel SWH	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
C406 .7.4: Heat Pump SWH	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
C406 .8: Enhanced Envelope Perf	4	6	3	4	3	3	1	6	4	4	4	5	4	6	5	8	9
C406 .9: Reduced Air Infiltration	1	1	1	2	1	1	NA	3	1	1	3	2	1	7	3	6	3

Table C406.1(5)
Additional Energy Efficiency Credits for Other^a Occupancies

Sub-section / Climate Zone:	1A	1B	2A	2B	3A	3B	3C	4A	4B	4C	5A	5B	5C	6 A	6 B	7	8
C406 .2.1: 5% Heating Eff Imprv.	NA	NA	NA	NA	1	1	1	1	1	2	1	2	1	2	2	3	3
C406 .2.2: 5% Cooling Eff Imprv.	5	5	4	4	3	3	2	2	2	1	1	2	1	1	1	1	1
C406 .2.3: 10 % Heating Eff Imprv.	NA	NA	NA	1	1	1	1	2	2	3	3	3	3	4	3	5	5
C406 .2.4: 10 % Cooling Eff Imprv.	8	9	8	7	5	5	3	4	4	2	2	3	2	2	2	2	2
C406 .3: Reduced Light Power	8	8	9	9	9	9	10	8	9	9	7	8	8	8	8	8	7
C406 .4: Enh. Digital Light Ctrl	2	2	2	2	2	2	2	2	2	2	2	3	2	2	2	2	1
C406 .5.1: On-site Renewable Egy.	8	8	8	8	8	8	8	8	8	7	7	7	7	7	7	7	7
C406 .6 : Dedicated OA Sys (DOAS)	3	4	3	3	4	3	2	5	3	3	5	4	3	7	5	7	6
C406 .7.2: Recovered/Renew SWH ^b	10	9	11	10	13	12	15	14	14	15	14	14	16	14	15	15	15
C406 .7.3: Eff fossil fuel SWH ^b	5	5	6	6	8	7	8	8	8	9	9	9	10	10	9	10	11
C406 .7.4: Heat Pump SWH ^b	6	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
C406 .8: Enhanced Envelope Perf	3	6	3	4	3	4	1	5	4	3	5	5	4	7	6	9	10
C406 .9: Reduced Air Infiltration	3	2	2	4	4	2	NA	6	2	2	6	4	1	10	5	7	4

a. Other occupancy groups include all Groups except for Groups B, R, I, E, and M.

b. For occupancy groups listed in C406 .7.1.

C406.1.1 Tenant spaces. Tenant spaces shall comply with sufficient options from Tables C406 .1(1) through C406 .1(5) to achieve a minimum number of 5 credits, where credits are selected from Section C406.2, C406.3, C406.4, C406.6 or C406.7. Alternatively, C406.7 or C406.10. Where the entire building complies using credits

from Section C406 .5, C406 .8 or C406 .9, tenant spaces within the building shall be deemed to comply with Section C406.5 where the entire building is in compliance. this section.

Exception: Previously occupied tenant spaces that comply with this code in accordance with Section C501.

C406.2 More efficient HVAC equipment performance. Equipment shall exceed the minimum efficiency requirements listed in Tables C403.3.2(1) through C403.3.2(7) ~~by 10 percent, in addition to the requirements of Section C403. Where multiple performance requirements are provided, the equipment shall exceed all requirements by 10 percent. 9) and Variable refrigerant flow systems shall exceed listed in the energy efficiency provisions of ANSI/ASHRAE/IESNA 90.1 by 10 percent. in accordance with Sections C406 .2.1, C406 .2.2, C406 .2.3 or C406 .2.4. Equipment shall also meet applicable requirements of Section C403. Energy efficiency credits for heating shall be selected from C406.2.1 or C406.2.3 and energy efficiency credits for cooling shall be selected from C406.2.2 or C406.2.4. Selected credits shall include a heating or cooling energy efficiency credit or both. Equipment not listed in Tables C403.3.2(1) through C403.3.2(7) 9) and Variable refrigerant flow systems not listed in the energy efficiency provisions of ANSI/ASHRAE/IES 90.1 shall be limited to 10 percent of the total building system capacity. capacity for heating equipment where selecting C406.2.1 or C406.2.3 and cooling equipment where selecting C406.2.2 or C406.2.4.~~

Add new text as follows:

C406.2.1 Five percent heating efficiency improvement Equipment shall exceed the minimum heating efficiency requirements by 5 percent.

C406.2.2 Five percent cooling efficiency improvement Equipment shall exceed the minimum cooling and heat rejection efficiency requirements by 5 percent. Where multiple cooling performance requirements are provided, the equipment shall exceed the annual energy requirement, including IEER, SEER, and IPLV.

C406.2.3 Ten percent heating efficiency improvement Equipment shall exceed the minimum heating efficiency requirements by 10 percent.

C406.2.4 Ten percent cooling efficiency improvement. Equipment shall exceed the minimum cooling and heat rejection efficiency requirements by 10 percent. Where multiple cooling performance requirements are provided, the equipment shall exceed the annual energy requirement, including IEER, SEER, and IPLV.

Revise as follows:

C406.5 On-site renewable energy. Buildings shall comply with Section C406 .5.1 or C406 .5.2. The total minimum ratings of on-site renewable energy systems shall be one of the following:

1. Not less than 1.71 Btu/h per square foot (5.4 W/m²) or 0.50 watts per square foot (5.4 W/m²) of conditioned floor area.
2. Not less than 3 percent of the energy used within the building for building mechanical and service water heating equipment and lighting regulated in Chapter 4.

C406.5 C406.5.1 On-site Basic renewable energy credits The total minimum ratings of on-site renewable energy systems not including systems used for credits under Section C406.7. shall be one of the following:

1. Not less than ~~1.71~~ 0.86 Btu/h per square foot (~~5.4~~ 2.7 W/m²) or ~~0.50~~ 0.25 watts per square foot (~~5.4~~ 2.7 W/m²) of conditioned floor area.
2. Not less than ~~3~~ 2 percent of the energy used within the building for building mechanical and service water heating equipment and lighting regulated in Chapter 4.

Add new text as follows:

C406.5.2 Enhanced Renewable Credits Where the total minimum ratings of on-site renewable energy

systems exceeds the rating in C406 .5.1(1), additional energy efficiency credits shall be determined based on Equation 4-13, rounded to the nearest whole number.

$$\text{AEEC}_{\text{RRa}} = \text{AEEC}_{2.5} \times \text{RRa} / \text{RR}_1 \text{ (Equation 4-13)}$$

Where:

AEEC_{RRa} = C406.5.2 additional energy efficiency credits

RRa = actual total minimum ratings of *on-site renewable energy* systems in Btu/h, watts per square foot or W/m^2

RR_1 = minimum ratings of *on-site renewable energy* systems required by C406.5.1(1) in Btu/h, watts per square foot or W/m^2

$\text{AEEC}_{2.5}$ = C406.5.1 credits from Tables C406.1(1) through C406.1(5)

Revise as follows:

C406.7 Reduced energy use in service water heating. Buildings shall comply with Sections C406 .7.1 and either C406 .7.2, C406 .7.3 or C406 .7.4. be of the following types to use this compliance method:

1. ~~Group R-1: Boarding houses, hotels or motels.~~
2. ~~Group I-2: Hospitals, psychiatric hospitals and nursing homes.~~
3. ~~Group A-2: Restaurants and banquet halls or buildings containing food preparation areas.~~
4. ~~Group F: Laundries.~~
5. ~~Group R-2.~~
6. ~~Group A-3: Health clubs and spas.~~
7. ~~Buildings showing a service hot water load of 10 percent or more of total building energy loads, as shown with an energy analysis as described in Section C407.~~

~~**C406.7 C406.7.1 Reduced energy use in service water heating. Building Type** Buildings shall be of the following types to use this compliance method To qualify for this credit, the building shall contain one of the following use groups and the additional energy efficiency credit shall be prorated by conditioned floor area of the portion of the building comprised of the following use groups:~~

1. ~~Group R-1: Boarding houses, hotels or motels.~~
2. ~~Group I-2: Hospitals, psychiatric hospitals and nursing homes.~~
3. ~~Group A-2: Restaurants and banquet halls or buildings containing food preparation areas.~~
4. ~~Group F: Laundries.~~
5. ~~Group R-2.~~
6. ~~Group A-3: Health clubs and spas.~~
7. Group E: Schools with full-service kitchens or locker rooms with showers
8. Buildings showing a service hot water load of 10 percent or more of total building energy loads, as shown with an energy analysis as described in Section C407.

~~**C406.7.1 C406.7.2 Load fraction. Recovered or renewable water heating** The building service water-heating system shall have one or more of the following that are sized to provide not less than 60-30 percent of the building's annual hot water requirements, or sized to provide 100-70 percent of the building's annual hot water requirements if the building shall otherwise is required to comply with Section C403.9.5:~~

1. ~~Waste heat recovery from service hot water, heat-recovery chillers, building equipment, or process equipment.~~
2. ~~On-site renewable energy water-heating systems.~~

Add new text as follows:

C406.7.3 Efficient fossil fuel water heater The combined input-capacity-weighted-average equipment rating of all fossil fuel water heating equipment in the building shall be not less than 95% Et or 0.95 EF. This option shall receive only half the listed credits for buildings required to comply with C404.2.1.

C406.7.4 Heat pump water heater Where electric resistance water heaters are allowed, all service hot water system heating requirements shall be met using heat pump technology with a combined input-capacity-weighted-average EF of 3.0. Air-source heat pump water heaters shall not draw conditioned air from within the building, except exhaust air that would otherwise be exhausted to the exterior.

C406.10 Efficient Kitchen Equipment For buildings and spaces designated as Group A-2 or facilities that include a commercial kitchen with at least one gas or electric fryer, all fryers, dishwashers, steam cookers and ovens shall comply with all of the following:

1. Achieve performance levels in accordance with the equipment specifications listed in Tables C406.10(1) through C406.10(4) when rated in accordance with the applicable test procedure.
2. Be installed prior to the issuance of the Certificate of Occupancy.
3. Have associated performance levels listed on the construction documents submitted for permitting.

Energy efficiency credits for efficient kitchen equipment shall be independent of climate zone and determined based on Equation 4-14, rounded to the nearest whole number.

$$AEEC_K = 20 \times Area_K / Area_B \text{ (Equation 4-14)}$$

Where:

$AEEC_K$ = C406.10 additional energy efficiency credits

$Area_K$ = Floor area of full service kitchen (ft² or m²)

$Area_B$ = Gross floor area of building (ft² or m²)

Table C406.10(1)
Minimum Efficiency Requirements: Commercial Fryers

Fryer Type	Heavy-Load Cooking Energy Efficiency	Idle Energy Rate	Test Procedure
Standard Open Deep-Fat Gas Fryers	≥ 50%	≤ 9,000 Btu/hr	ASTM Standard F1361-17
Standard Open Deep-Fat Electric Fryers	≥ 83%	≤ 800 watts	
Large Vat Open Deep-Fat Gas Fryers	≥ 50%	≤ 12,000 Btu/hr	ASTM Standard F2144-17
Large Vat Open Deep-Fat Electric Fryers	≥ 80%	≤ 1,100 watts	

Table C406.10(2)
Minimum Efficiency Requirements: Commercial Steam Cookers

<u>Fuel Type</u>	<u>Pan Capacity</u>	<u>Cooking Energy Efficiency^a</u>	<u>Idle Rate</u>	<u>Test Procedure</u>
<u>Electric Steam</u>	<u>3-pan</u>	<u>50%</u>	<u>400 watts</u>	<u>ASTM Standard F1484-18</u>
	<u>4-pan</u>	<u>50%</u>	<u>530 watts</u>	
	<u>5-pan</u>	<u>50%</u>	<u>670 watts</u>	
	<u>6-pan and larger</u>	<u>50%</u>	<u>800 watts</u>	
<u>Gas Steam</u>	<u>3-pan</u>	<u>38%</u>	<u>6,250 Btu/h</u>	
	<u>4-pan</u>	<u>38%</u>	<u>8,350 Btu/h</u>	
	<u>5-pan</u>	<u>38%</u>	<u>10,400 Btu/h</u>	
	<u>6-pan and larger</u>	<u>38%</u>	<u>12,500 Btu/h</u>	

a. Cooking Energy Efficiency is based on heavy load (potato) cooking capacity

Table C406.10(3)
Minimum Efficiency Requirements: Commercial Dishwashers

<u>Machine Type</u>	<u>High Temp Efficiency Requirements</u>		<u>Low Temp Efficiency Requirements</u>		<u>Test Procedure</u>
	<u>Idle Energy Rate^a</u>	<u>Water Consumption^b</u>	<u>Idle Energy Rate^a</u>	<u>Water Consumption^b</u>	
<u>Under Counter</u>	<u>≤ 0.50 kW</u>	<u>≤ 0.86 GPR</u>	<u>≤ 0.50 kW</u>	<u>≤ 1.19 GPR</u>	<u>ASTM Standard F1696-18</u>
<u>Stationary Single Tank Door</u>	<u>≤ 0.70 kW</u>	<u>≤ 0.89 GPR</u>	<u>≤ 0.60 kW</u>	<u>≤ 1.18 GPR</u>	
<u>Pot, Pan, and Utensil</u>	<u>≤ 1.20 kW</u>	<u>≤ 0.58 GPR</u>	<u>≤ 1.00 kW</u>	<u>≤ 0.58 GPSF</u>	
<u>Single Tank Conveyor</u>	<u>≤ 1.50 kW</u>	<u>≤ 0.70 GPR</u>	<u>≤ 1.50 kW</u>	<u>≤ 0.79 GPR</u>	
<u>Multiple Tank Conveyor</u>	<u>≤ 2.25 kW</u>	<u>≤ 0.54 GPR</u>	<u>≤ 2.00 kW</u>	<u>≤ 0.54 GPR</u>	<u>ASTM Standard F1920-15</u>
<u>Single Tank Flight Type</u>	<u>Reported</u>	<u>GPH ≤ 2.975x + 55.00</u>	<u>Reported</u>	<u>GPH ≤ 2.975x + 55.00</u>	
<u>Multiple Tank Flight Type</u>	<u>Reported</u>	<u>GPH ≤ 4.96x + 17.00</u>	<u>Reported</u>	<u>GPH ≤ 4.96x + 17.00</u>	

a. Idle results shall be measured with the door closed and represent the total idle energy consumed by the machine including all tank heater(s) and controls. Booster heater (internal or external) energy consumption shall not be part of this measurement unless it cannot be separately monitored.

b. GPR = gallons per rack; GPSF = gallons per square foot of rack; GPH = gallons per hour; x = sf of conveyor belt (i.e., W*L) /min (max conveyor speed).

Table C406.10(4)
Minimum Efficiency Requirements: Commercial Ovens

<u>Fuel Type</u>	<u>Classification</u>	<u>Idle Rate</u>	<u>Cooking-Energy Efficiency, %</u>	<u>Test Procedure</u>
<u>Convection Ovens</u>				

	Full-Size	$\leq 12,000 \text{ Btu/h}$	≥ 46	ASTM F1496-13
Electric	Half-Size	$\leq 1.0 \text{ Btu/h}$	≥ 71	
	Full-Size	$\leq 1.60 \text{ Btu/h}$		
Combination Ovens				
	Steam Mode	$\leq 200P^a + 6,511 \text{ Btu/h}$	≥ 41	ASTM F2861-17
	Convection Mode	$\leq 150P^a + 5,425 \text{ Btu/h}$	≥ 56	
Electric	Steam Mode	$\leq 0.133P^a + 0.6400 \text{ kW}$	≥ 55	
	Convection Mode	$\leq 0.080P^a + 0.4989 \text{ kW}$	≥ 76	
Rack Ovens				
	Single	$\leq 25,000 \text{ Btu/h}$	≥ 48	ASTM F2093-18
	Double	$\leq 30,000 \text{ Btu/h}$	≥ 52	

a. P = Pan Capacity: The number of steam table pans the combination oven is able to accommodate as per the ASTM F1495-14a standard specification.

Add new standard(s) as follows:

ASTM

ASTM International
100 Barr Harbor Drive, P.O. Box
C700
West Conshohocken PA 19428-
2959

F1361-17: Standard Test Method for Performance of Open Deep Fat Fryers

ASTM

ASTM International
100 Barr Harbor Drive, P.O. Box
C700
West Conshohocken PA 19428-
2959

F2144-17: Standard Test Method for Performance of Large Open Vat Fryers

ASTM

ASTM International
100 Barr Harbor Drive, P.O. Box
C700
West Conshohocken PA 19428-
2959

F1484-18: Standard Test Method for Performance of Steam Cookers

ASTM

ASTM International
100 Barr Harbor Drive, P.O. Box
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West Conshohocken PA 19428-
2959

F1696-18: Standard Test Method for Energy Performance of Stationary-Rack, Door-Type Commercial Dishwashing Machines

ASTM

ASTM International
100 Barr Harbor Drive, P.O. Box
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West Conshohocken PA 19428-
2959

F1920-15: Standard Test Method for Performance of Rack Conveyor Commercial Dishwashing Machines

ASTM

ASTM International
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West Conshohocken PA 19428-
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F1496-13: Standard Test Method for Performance of Convection Ovens

ASTM

ASTM International
100 Barr Harbor Drive, P.O. Box
C700
West Conshohocken PA 19428-
2959

F2861-17: Standard Test Method for Enhanced Performance of Combination Oven in Various Modes

ASTM

ASTM International
100 Barr Harbor Drive, P.O. Box
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West Conshohocken PA 19428-
2959

F2093-18: Standard Test Method for Performance of Rack Ovens

ASTM

ASTM International
100 Barr Harbor Drive, P.O. Box
C700
West Conshohocken PA 19428-
2959

F1495-14a: Standard Specification for Combination Oven Electric or Gas Fired

Reason: C406 Credits for Efficient Kitchen Equipment

Kitchen equipment uses a large share of building energy use in restaurants, schools, dormitories, hotels, and other facilities with full service kitchens. More efficient equipment saves energy by improving the heat transfer to the cooking process, either through better equipment insulation or other innovations in the appliances. This proposal provides more flexibility to building designers when it is added to the energy efficiency credit choices. It specifically addresses the large energy use of kitchen equipment.

This proposal allows credit for efficient kitchen equipment in Section C406 where extra efficiency options are required. There is a separate proposal that modifies Section C406 from the current requirement to select one of the listed options, to assigning credits to each measure and requiring a certain number of credits (CE218-19).

For clarity, that proposal is included here. In addition to the changes that are the same as that proposal, this proposal adds:

- Requirements for a new kitchen equipment efficiency option.
- A formula to calculate the extra efficiency credits based on the ratio of kitchen area to building area.
- Adding the reference to the new kitchen equipment efficiency credits in the tenant section (C406.1.1).

Bibliography:

Hart, R., R. Nambiar, M. Tyler, M., Y. Xie, and J. Zhang. "Relative Credits for Extra Efficiency Measures: Technical Brief." Pacific Northwest National Laboratory (PNNL), Richland, WA (US), January 2019.

https://www.pnnl.gov/main/publications/external/technical_reports/PNNL-28370Rev.1.pdf.

Cost Impact: The code change proposal will not increase or decrease the cost of construction. The current proposal does not require more investment, but rather expands existing options permitted under the 2018 IECC Section C406. The intention is to identify additional options to increase flexibility and more effectively utilize new technologies and construction practices. There is not expected to be an increased cost, as this simply increases the options for C406 beyond what is included in current code. In some cases, costs may be reduced, as the outlined approach provides partial credit for selected items as well as credit for items that may have previously been included in the building design without credit. Costs, and cost effectiveness, are not evaluated for individual measures due to the vast number of potential combinations amongst building types, climates, and selected options. Actual costs will vary based on the items selected by the building designer—architects, engineers, and other involved trades—based on the needs and goals of the individual project.

Staff Analysis: A review of the standards proposed for inclusion in the code, ASTM F1361-17, F2144-17, F1484-18, F1696-18, F1920-15, F1496-13, F2861-17, F2093-18 and F1495-14a 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.

Proposal # 4927

CE240-19

CE241-19

IECC: SECTION C406, C406.1, C406.1.1, C406.10 (New), Table C406.10 (1) (New), Table C406.10(2) (New), Table C406.10 (3) (New), Table C406.10(4) (New), ASTM Chapter 06 (New)

Proponent: Mark Lyles, representing Northwest Energy Codes Group (markl@newbuildings.org)

2018 International Energy Conservation Code

SECTION C406 ADDITIONAL EFFICIENCY PACKAGE OPTIONS REQUIREMENTS

C406.1 Requirements. ~~Additional energy efficiency requirements.~~ Buildings ~~New buildings~~ shall comply with one or more of the following:

1. More efficient HVAC performance in accordance with Section C406.2.
2. Reduced lighting power in accordance with Section C406.3.
3. Enhanced lighting controls in accordance with Section C406.4.
4. On-site supply of renewable energy in accordance with Section C406.5.
5. Provision of a dedicated outdoor air system for certain HVAC equipment in accordance with Section C406.6.
6. High-efficiency service water heating in accordance with Section C406.7.
7. Enhanced envelope performance in accordance with Section C406.8.
8. Reduced air infiltration in accordance with Section C406.9
9. Efficient Kitchen Equipment in accordance with Section C406.10.

C406.1.1 Tenant spaces. Tenant spaces shall comply with Section C406.2, C406.3, C406.4, C406.6 ~~or C406.7. Alternatively, C406.7, or C406.10. Where the entire building complies with Section C406.5, C406.8, or C406.9, tenant spaces within the building shall be deemed to comply with Section C406.5 where the entire building is in compliance. this section.~~

Exception: Previously occupied tenant spaces that comply with this code in accordance with Section C501.

Add new text as follows:

C406.10 Efficiency Kitchen Equipment For buildings and spaces designated as Group A-2 or facilities that include a commercial kitchen with at least one gas or electric fryer, all fryers, dishwashers, steam cookers and ovens shall comply with all of the following:

1. Achieve performance levels in accordance with the equipment specifications listed in Tables C406.10 (1) through (4) when rated in accordance with the applicable test procedure.
2. Be installed prior to the issuance of the Certificate of Occupancy.
3. Have associated performance levels listed on the construction documents submitted for permitting.

Table C406.10 (1)
Minimum Efficiency Requirements: Commercial Fryers

	<u>Heavy-Load Cooking Energy Efficiency</u>	<u>Idle Energy Rate</u>	<u>Test Procedure</u>
<u>Standard Open Deep-Fat Gas Fryers</u>	<u>≥ 50%</u>	<u>≤ 9,000 Btu/hr</u>	<u>ASTM Standard</u>

<u>Standard Open Deep-Fat Electric Fryers</u>	$\geq 83\%$	≤ 800 watts	<u>F1361-17</u>
<u>Large Vat Open Deep-Fat Gas Fryers</u>	$\geq 50\%$	$\leq 12,000$ Btu/hr	<u>ASTM Standard F2144-17</u>
<u>Large Vat Open Deep-Fat Electric Fryers</u>	$\geq 80\%$	$\leq 1,100$ watts	

Table C406.10(2)

Minimum Efficiency Requirements: Commercial Steam Cookers

<u>Fuel Type</u>	<u>Pan Capacity</u>	<u>Cooking Energy Efficiency^a</u>	<u>Idle Rate</u>	<u>Test Procedure</u>
<u>Electric Steam</u>	<u>3-pan</u>	<u>50%</u>	<u>400 watts</u>	<u>ASTM Standard F1484-18</u>
	<u>4-pan</u>	<u>50%</u>	<u>530 watts</u>	
	<u>5-pan</u>	<u>50%</u>	<u>670 watts</u>	
	<u>6-pan and larger</u>	<u>50%</u>	<u>800 watts</u>	
<u>Gas Steam</u>	<u>3-pan</u>	<u>38%</u>	<u>6,250 Btu/h</u>	
	<u>4-pan</u>	<u>38%</u>	<u>8,350 Btu/h</u>	
	<u>5-pan</u>	<u>38%</u>	<u>10,400 Btu/h</u>	
	<u>6-pan and larger</u>	<u>38%</u>	<u>12,500 Btu/h</u>	

^a Cooking Energy Efficiency is based on heavy load (potato) cooking capacity

Table C406.10 (3)

Minimum Efficiency Requirements: Commercial Dishwashers

<u>Machine Type</u>	<u>High Temp Efficiency Requirements</u>		<u>Low Temp Efficiency Requirements</u>		<u>Test Procedure</u>
-	<u>Idle Energy Rate^a</u>	<u>Water Consumption^b</u>	<u>Idle Energy Rate^a</u>	<u>Water Consumption^b</u>	
<u>Under Counter</u>	≤ 0.50 kW	≤ 0.86 GPR	≤ 0.50 kW	≤ 1.19 GPR	<u>ASTM Standard F1696-18, Standard Test Method for Energy Performance of Stationary-Rack, Door-Type Commercial Dishwashing Machines</u>
<u>Stationary Single Tank Door</u>	≤ 0.70 kW	≤ 0.89 GPR	≤ 0.60 kW	≤ 1.18 GPR	
<u>Pot, Pan, and Utensil</u>	≤ 1.20 kW	≤ 0.58 GPR	≤ 1.00 kW	≤ 0.58 GPSF	
<u>Single Tank Conveyor</u>	≤ 1.50 kW	≤ 0.70 GPR	≤ 1.50 kW	≤ 0.79 GPR	
<u>Multiple Tank Conveyor</u>	≤ 2.25 kW	≤ 0.54 GPR	≤ 2.00 kW	≤ 0.54 GPR	
<u>Single Tank Flight Type</u>	<u>Reported</u>	<u>GPH $\leq 2.975x + 55.00$</u>	<u>Reported</u>	<u>GPH $\leq 2.975x + 55.00$</u>	<u>ASTM Standard F1920-15, Standard Test Method for Performance of Rack Conveyor Commercial Dishwashing Machines</u>

Multiple Tank Flight Type	Reported	GPH $\leq 4.96x$ + 17.00	Reported	GPH $\leq 4.96x$ + 17.00
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^aIdle results shall be measured with the door closed and represent the total idle energy consumed by the machine including all tank heater(s) and controls. Booster heater (internal or external) energy consumption shall not be part of this measurement unless it cannot be separately monitored.

^bGPR = gallons per rack; GPSF = gallons per square foot of rack; GPH = gallons per hour; x = sf of conveyor belt (i.e., W*L) /min (max conveyor speed).

Table C406.10(4)
Minimum Efficiency Requirements: Commercial Ovens

Fuel Type	Classification	Idle Rate	Cooking-Energy Efficiency, %	Test Procedure
Convection Ovens				–
Gas	Full-Size	≤ 12,000 Btu/h	≥ 46	ASTM F1496 - 13
Electric	Half-Size	≤ 1.0 Btu/h	≥ 71	
	Full-Size	≤ 1.60 Btu/h		
Combination Ovens				–
Gas	Steam Mode	≤ 200P ^a +6,511 Btu/h	≥ 41	ASTM F2861 - 17
	Convection Mode	≤ 150P ^a +5,425 Btu/h	≥ 56	
Electric	Steam Mode	≤ 0.133P ^a +0.6400 kW	≥ 55	
	Convection Mode	≤ 0.080P ^a +0.4989 kW	≥ 76	
Rack Ovens				–
Gas	Single	≤ 25,000 Btu/h	≥ 48	ASTM F2093 - 18
	Double	≤ 30,000 Btu/h	≥ 52	

^aP = Pan Capacity: The number of steam table pans the combination oven is able to accommodate as per the ASTM F – 1495 – 14a standard specification.

ASTM

ASTM International
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F1361-17:
Standard Test Method for Performance of Open Deep Fat Fryers

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ASTM International
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West Conshohocken PA 19428-
2959

F2144-17:

Standard Test Method for Performance of Large Open Vat Fryers

ASTM

ASTM International
100 Barr Harbor Drive, P.O. Box
C700
West Conshohocken PA 19428-
2959

F1484-18: Standard Test Method for Performance of Steam Cookers

ASTM

ASTM International
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West Conshohocken PA 19428-
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F1696-18:

Standard Test Method for Energy Performance of Stationary-Rack, Door-Type Commercial Dishwashing Machines

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F1920-15:

Standard Test Method for Performance of Rack Conveyor Commercial Dishwashing Machines

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1496-13: Standard Test Method for Performance of Convection Ovens

ASTM

ASTM International
100 Barr Harbor Drive, P.O. Box
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West Conshohocken PA 19428-
2959

F2861-17: Standard Test Method for Enhanced Performance of Combination Oven in Various Modes

ASTM

ASTM International
100 Barr Harbor Drive, P.O. Box
C700
West Conshohocken PA 19428-
2959

F2093-18:

F1495-14a: Standard Specification for Combination Oven Electric or Gas Fired

Reason: C406 add Efficient Kitchen Equipment

This proposal adds a new option in Section C406, increasing flexibility in meeting this additional efficiency requirement. This proposal allows selection of a provision with high efficiency kitchen equipment in Section C406 where extra efficiency options are required and includes the following:

- Adds provisions to improve kitchen equipment efficiency.
- Revises Section C406.1.1 on tenant spaces to include the new kitchen equipment option in the tenant space portion and update the building compliance portion based on whole building compliance.

Kitchen equipment uses a large share of building energy use in restaurants, schools, dormitories, hotels, and other facilities with full service kitchens. More efficient equipment saves energy by improving the heat transfer to the cooking process, either through better equipment insulation or other innovations in the appliances. This proposal provides more flexibility to building designers when it is added to the energy efficiency credit choices. It specifically addresses the large energy use of kitchen equipment.

Bibliography: Hart, R., R. Nambiar, M. Tyler, M., Y. Xie, and J. Zhang. "Relative Credits for Extra Efficiency Measures: Technical Brief." Pacific Northwest National Laboratory (PNNL), Richland, WA (US), January 2019. https://www.pnnl.gov/main/publications/external/technical_reports/PNNL-28370Rev.1.pdf.

Cost Impact: The code change proposal will not increase or decrease the cost of construction. The current proposal does not require more investment, but rather expands existing options permitted under the 2018 IECC. The intention is to identify additional options to increase flexibility and more effectively utilize new technologies and construction practices. There is not expected to be an increased cost, as this simply increases the options for C406 beyond what is included in current code. Actual costs will vary based on the items selected by the building designer—architects, engineers, and other involved trades—based on the needs and goals of the individual project.

Proposal # 5770

CE241-19

CE242-19

IECC: C406.1, C406.11 (New)

Proponent: Steven Rosenstock, Edison Electric Institute, representing Edison Electric Institute
(srosenstock@eei.org)

2018 International Energy Conservation Code

Revise as follows:

C406.1 Requirements. Buildings shall comply with one or more of the following:

1. More efficient HVAC performance in accordance with Section C406.2.
2. Reduced lighting power in accordance with Section C406.3.
3. Enhanced lighting controls in accordance with Section C406.4.
4. On-site supply of renewable energy in accordance with Section C406.5.
5. Provision of a dedicated outdoor air system for certain HVAC equipment in accordance with Section C406.6.
6. High-efficiency service water heating in accordance with Section C406.7.
7. Enhanced envelope performance in accordance with Section C406.8.
8. Reduced air infiltration in accordance with Section C406.9
9. Electric Vehicle Supply Equipment in accordance with Section 406.11.

Add new text as follows:

C406.11 Electric Vehicle Supply Equipment. In buildings with at least 20 parking spaces, electric vehicle charging stations rated at 208/240 Volts and 40-80 Amps (Level 2) shall be installed to serve at least 5 percent of the parking spaces. Fractional values shall be rounded up to the nearest whole number.

Reason: There are now over 1 million electric vehicles being driven in the United States. As of November 2018, over 300,000 light duty vehicles were sold in the United States.

According to a report published by the Edison Electric Institute and the Edison Foundation Institute for Electric Innovation:

- The stock of EVs in the US is projected to reach **18.7 million in 2030**, up from slightly more than 1 million at the end of 2018. This is approximately 7% of the 259 million vehicles (cars and light trucks) expected to be on U.S. roads in 2030.
- It took 8 years to sell 1 million EVs. The report projects that the next 1 million EVs will be on the road in less than 3 years—by early 2021.
- Annual sales of EVs will exceed 3.5 million vehicles in 2030, reaching more than 20 percent of annual vehicle sales in 2030. EV sales are estimated to be 1.4 million in 2025.

Most importantly,

- About 9.6 million charge ports will be required to support the 18.7 million EVs in 2030. This represents a significant investment in EV charging infrastructure. About 1.2 million Level 2 charging ports will be needed at workplaces, according to the report.

This proposal provides an option to install the EV charging station at the lowest cost - when a building is being built.

In addition, Level 2 charging stations are compatible with all electric vehicles that are sold in the US (which have charging connections that meet the SAE J1772 specifications), and they can provide anywhere from 10 to 50 miles of driving range per hour of charging (depending on the size of the EV battery and the on-board charging rate). There are multiple vendors of Level 2 charging stations, and there are state and utility incentives available in many parts of the US for their installation.

This proposal will improve the efficiency of transportation associated with the building (transportation that moves people, products, and services to and from the building). Electric vehicles get anywhere from 80 to over 130 miles per gallon equivalent (MPGe).

Bibliography: EEI and IEI, *Electric Vehicle Sales Forecast and the Charging Infrastructure Required Through 2030*, November 2018

http://www.edisonfoundation.net/iei/publications/Documents/IEI_EEI%20EV%20Forecast%20Report_Nov2018.pdf

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

This is one of several efficiency options that increase the cost of construction. For Level 2 charging stations, the total installation costs per station will vary from \$1000 to over \$2000, depending on the number of stations installed and any addition conduits/raceways/panel spaces that are needed. The cost for these stations are likely to be similar or lower than the cost of other efficiency options in Section C406.

Proposal # 4457

CE242-19

CE243-19

IECC: C407.3

Proponent: Steven Rosenstock, Edison Electric Institute, representing Edison Electric Institute
(srosenstock@eei.org)

2018 International Energy Conservation Code

Revise as follows:

C407.3 Performance-based compliance. Compliance based on total building performance requires that a proposed building (*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 Price and Expenditure Report, Data System Prices and Expenditures reports. *Code officials* shall be permitted to require time-of-use pricing in energy cost calculations. The reduction in energy cost of the proposed design associated with *on-site renewable energy* shall be not more than 5 percent of the total energy cost. The amount of renewable energy purchased from off-site sources shall be the same in the *standard reference design* and the *proposed design*.

Exception: Jurisdictions that require site energy (1 kWh = 3413 Btu) rather than energy cost as the metric of comparison.

Reason: This is an editorial change to be consistent with the language that is already in Section R405.3. This information can be found at the DOE/EIA State Energy Data System website:
<https://www.eia.gov/state/seds/>

Bibliography: U.S. Energy Information Administration *State Profiles and Energy Estimates*, "About SEDS" website <https://www.eia.gov/state/seds/>

Cost Impact: The code change proposal will not increase or decrease the cost of construction
This is an editorial change / update that has no cost impact.

Proposal # 4706

CE243-19

CE244-19

IECC: C407.3

Proponent: Craig Conner, representing self (craig.conner@mac.com)

2018 International Energy Conservation Code

Revise as follows:

C407.3 Performance-based compliance. Compliance based on total building performance requires that a proposed building (*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 Price and Expenditure Report*. *Code officials* shall be permitted to require time-of-use pricing in energy cost calculations. ~~The reduction in energy cost of the proposed design associated with on-site renewable energy shall be not more than 5 percent of the total energy cost. The amount of renewable energy purchased from off-site sources shall be the same in the standard reference design and the proposed design.~~

Exception: Jurisdictions that require site energy (1 kWh = 3413 Btu) rather than energy cost as the metric of comparison.

Reason: The goal should be to reduce the use of non-renewable energy, not to limit the use of renewable energy. Most of this type of limitation is an attempt by some types of products to restrict their competition. Very high efficiency and near zero energy buildings are usually well above 5% renewable energy. Many commercial buildings need off-site renewables to get to very low net energy. There simply is not enough roof top on large buildings to get sufficient renewable energy to get to very low levels of net energy use. Advocating very low or zero energy is inconsistent with advocating renewables must to onsite. Many times it simply is not possible to find the needed surface area on a large building.

Cost Impact: The code change proposal will decrease the cost of construction
Renewables can be part of the least cost way to get to low energy buildings

Proposal # 5659

CE244-19

CE245-19

IECC: C407.3

Proponent: Joseph H. Cain, Solar Energy Industries Association (SEIA), representing Solar Energy Industries Association (SEIA) (JoeCainPE@gmail.com)

2018 International Energy Conservation Code

Revise as follows:

C407.3 Performance-based compliance. Compliance based on total building performance requires that a proposed building (*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 Price and Expenditure Report*. *Code officials* shall be permitted to require time-of-use pricing in energy cost calculations. The reduction in energy cost of the proposed design ~~associated with on-site renewable energy shall be not more than 5 percent of the total energy cost. The amount of renewable energy purchased from off-site sources shall be the same in the standard reference design and the proposed design shall be permitted to include renewable energy systems.~~

Exception: Jurisdictions that require site energy (1 kWh = 3413 Btu) rather than energy cost as the metric of comparison.

Reason: 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.

When looking forward for future energy codes, Zero Net Energy and Zero Carbon are common goals/aspirations. It should be clear that we cannot get to Zero Net Energy or Zero Carbon buildings without renewable energy systems. This is just as true for commercial buildings as for residential buildings.

In the process of development of the 2018 IECC, Proposal CE250-16 sought to constrain the contribution of renewable energy systems in the performance approach. The original proposal set a renewable backstop of 10% of the energy cost, which is so restrictive that builders are unlikely to install a renewable energy system for the purpose of code compliance. Either they do or they don't, but a 10% constraint does not allow enough compliance credit to influence the economics or the decision to install or not install a solar PV system with the original construction. During the Committee Action Hearings, a modification by a committee member lowered the constraint even further, to only 5% of energy cost. By inspection, 5% is approximately equal to 0%. 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. This does not provide an attractive option for builders to install renewable energy systems.

This proposal gives builders credit for what they do, and encourages the use of energy efficiency measures plus renewable energy systems.

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 # 5562

CE245-19

CE246-19

IECC: C407.3

Proponent: Ted Williams, representing American Gas Association (twilliams@aga.org)

2018 International Energy Conservation Code

Revise as follows:

C407.3 Performance-based compliance. Compliance based on total building performance requires that a proposed building (*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 Price and Expenditure Report*. *Code officials* shall be permitted to require time-of-use pricing in energy cost calculations. The reduction in energy cost of the proposed design associated with *on-site renewable energy* shall be not more than 5 percent of the total energy cost. The amount of renewable energy purchased from off-site sources shall be the same in the *standard reference design* and the *proposed design*.

Exception: ~~Jurisdictions that require site energy (1 kWh = 3413 Btu) rather than energy cost as the metric of comparison. Where energy use based on source energy expressed in Btu or Btu per square foot of conditioned floor area is substituted for the energy cost, the source energy multipliers shall be 3.16 for electricity and 1.1 for fuels other than electricity, or other multipliers for national or regional annual average energy consumption from nationally-recognized and validated data sources.~~

Reason: The proposed change brings C407.3 into greater consistency with R405.3 and 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 may 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 C407.3 focusing on energy cost is not consistent with the intent of the IECC as stated in C101.3, 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 # 5567

CE246-19

CE247-19

IECC: TABLE C407.5.1(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:

TABLE C407.5.1(1)

SPECIFICATIONS FOR THE STANDARD REFERENCE AND PROPOSED DESIGNS

Portions of table not shown remain unchanged.

BUILDING COMPONENT CHARACTERISTICS	STANDARD REFERENCE DESIGN	PROPOSED DESIGN
Walls, above-grade	Type: <u>same as proposed</u> Mass wall where proposed wall is mass; otherwise steel-framed wall	As proposed
	Gross area: same as proposed	As proposed
	U-factor: as specified in Table C402.1.4	As proposed
	Solar absorptance: 0.75	As proposed
	Emittance: 0.90	As proposed

SWHF = Service water heat recovery factor, DWHR = Drain water heat recovery.

- a. Where no heating system exists or has been specified, the heating system shall be modeled as fossil fuel. The system characteristics shall be identical in both the standard reference design and proposed design.
- b. The ratio between the capacities used in the annual simulations and the capacities determined by sizing runs shall be the same for both the standard reference design and proposed design.
- c. Where no cooling system exists or no cooling system has been specified, the cooling system shall be modeled as an air-cooled single-zone system, one unit per thermal zone. The system characteristics shall be identical in both the standard reference design and proposed design.
- d. If an economizer is required in accordance with Table C403.5(1) and where no economizer exists or is specified in the proposed design, then a supply-air economizer shall be provided in the standard reference design in accordance with Section C403.5.
- e. The SWHF shall be applied as follows:
 1. Where potable water from the DWHR unit supplies not less than one shower and not greater than two showers, of which the drain water from the same showers flows through the DWHR unit then $SWHF = [1 - (DWHR \text{ unit efficiency} \cdot 0.36)]$.
 2. Where potable water from the DWHR unit supplies not less than three showers and not greater than four showers, of which the drain water from the same showers flows through the DWHR unit then $SWHF = [1 - (DWHR \text{ unit efficiency} \cdot 0.33)]$.
 3. Where potable water from the DWHR unit supplies not less than five showers and not greater than six showers, of which the drain water from the same showers flows through the DWHR unit, then $SWHF = [1 - (DWHR \text{ unit efficiency} \cdot 0.26)]$.

4. Where Items 1 through 3 are not met, SWHF = 1.0.

Reason: The purpose of this code change proposal is to improve the efficiency of above-grade walls by eliminating an unnecessary loophole. The current standard reference design assumption for above-grade walls is based on mass walls (where mass walls are proposed) or steel-framed walls (regardless of whether steel or wood-framed walls are proposed). The result is that when a building design incorporates wood-framed walls (which are more efficient than steel-framed walls), the building receives a trade-off credit for the difference in efficiency between the steel and wood framing, even though the choice of framing type may have little or nothing to do with efficiency. While we would prefer a single reference design and related budget, if there are to be different standard reference designs for steel versus mass walls, then logically there should be a different design for wood walls as well.

This proposal applies a more consistent approach that will result in improved efficiency. Whether the wall is mass wall, steel-framed, or wood-framed, the baseline will be the insulation requirement for the corresponding wall type set in the prescriptive table. This will eliminate the trade-off loophole and improve efficiency in most climate zones and occupancy types.

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

This proposal will increase the cost of construction for buildings with wood-framed walls because it will either require additional insulation or the incorporation of other energy efficient measures in Section C407 (to be consistent with the current prescriptive path requirements for wood framing). However, we view this as the elimination of an unnecessary loophole that is applying an incorrect baseline in the simulated performance alternative.

Proposal # 4205

CE247-19

CE248-19 Part I

PART I — IECC: Part I: TABLE C407.5.1(1)

IECC: Part II: TABLE R405.5.2(1) [(TABLE N1105.2(1))]

PART II — IECC: TABLE R405.5.2(1) [IRC N1105.2(1)]

Proponent: Erika Burns, D+R International, representing Attachments Energy Rating Council (AERC)
(aerc316@gmail.com)

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

2018 International Energy Conservation Code

Revise as follows:

TABLE C407.5.1(1)

SPECIFICATIONS FOR THE STANDARD REFERENCE DESIGN AND PROPOSED DESIGNS

Portions of table not shown remain unchanged.

BUILDING COMPONENT CHARACTERISTICS	STANDARD REFERENCE DESIGN	PROPOSED DESIGN
Vertical fenestration other than opaque doors	Area 1.The proposed vertical fenestration area; where the proposed vertical fenestration area is less than 40 percent of above-grade wall area. 2.40 percent of above-grade wall area; where the proposed vertical fenestration area is 40 percent or more of the above-grade wall area.	As proposed
	U-factor: as specified in Table C402.4	As proposed
	SHGC: as specified in Table C402.4 except that for climates with no requirement (NR) SHGC = 0.40 shall be used	As proposed
	<u>Shading:</u> External shading and PF: None <u>Automatic and manually controlled shading devices such as blinds or shades are not required to be modeled.</u>	As proposed <u>Manual blinds or shades shall be modeled the same as in the standard reference design.</u> <u>Automatically controlled blinds or shades shall be modeled.</u>

Skylights	Area 1.The proposed skylight area; where the proposed skylight area is less than that permitted by Section C402.1.	As proposed
	2.The area permitted by Section C402.1; where the proposed skylight area exceeds that permitted by Section C402.1 U-factor: as specified in Table C402.4	As proposed
	SHGC: as specified in Table C402.4 except that for climates with no requirement (NR) SHGC = 0.40 shall be used.	As proposed
	<u>Shading: Automatic and manually controlled shading devices such as blinds or shades are not required to be modeled.</u>	<u>Manual blinds or shades shall be modeled the same as in the standard reference design. Automatically controlled blinds or shades shall be modeled.</u>

SWHF = Service water heat recovery factor, DWHR = Drain water heat recovery.

- a. Where no heating system exists or has been specified, the heating system shall be modeled as fossil fuel. The system characteristics shall be identical in both the standard reference design and proposed design.
- b. The ratio between the capacities used in the annual simulations and the capacities determined by sizing runs shall be the same for both the standard reference design and proposed design.
- c. Where no cooling system exists or no cooling system has been specified, the cooling system shall be modeled as an air-cooled single-zone system, one unit per thermal zone. The system characteristics shall be identical in both the standard reference design and proposed design.
- d. If an economizer is required in accordance with Table C403.5(1) and where no economizer exists or is specified in the proposed design, then a supply-air economizer shall be provided in the standard reference design in accordance with Section C403.5.
- e. The SWHF shall be applied as follows:
 1. Where potable water from the DWHR unit supplies not less than one shower and not greater than two showers, of which the drain water from the same showers flows through the DWHR unit then $SWHF = [1 - (DWHR \text{ unit efficiency} \cdot 0.36)]$.
 2. Where potable water from the DWHR unit supplies not less than three showers and not greater than four showers, of which the drain water from the same showers flows through the DWHR unit then $SWHF = [1 - (DWHR \text{ unit efficiency} \cdot 0.33)]$.
 3. Where potable water from the DWHR unit supplies not less than five showers and not greater than six showers, of which the drain water from the same showers flows through the DWHR unit, then $SWHF = [1 - (DWHR \text{ unit efficiency} \cdot 0.26)]$.
 4. Where Items 1 through 3 are not met, $SWHF = 1.0$.

Proposal # 4670

CE248-19 Part I

CE248-19 Part II

IECC: TABLE R405.5.2(1) [IRC N1105.2(1)]

Proponent: Erika Burns, D+R International, representing Attachments Energy Rating Council (AERC)
(aerc316@gmail.com)

2018 International Energy Conservation Code

TABLE R405.5.2(1) [IRC N1105.2(1)]

SPECIFICATIONS FOR THE STANDARD REFERENCE AND PROPOSED DESIGNS

Portions of table not shown remain unchanged.

BUILDING COMPONENT	STANDARD REFERENCE DESIGN	PROPOSED DESIGN
Vertical fenestration other than opaque doors	Total area ^h = (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
	Orientation: equally distributed to four cardinal compass orientations (N, E, S & W).	As proposed
	<i>U</i> -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: $0.92 - (0.21 \times \text{SHGC for the standard reference design})$.	Interior shade fraction: $0.92 - (0.21 \times \text{SHGC as proposed})$
	External shading: <u>Automatic and manually controlled shading devices such as blinds or shades are not required to be modeled.</u>	<u>Manual blinds or shades shall be modeled the same as in the standard reference design. Automatically controlled blinds or shades shall be modeled.</u>
Skylights	None. <u>Shading: Automatic and manually controlled shading devices such as blinds or shades are not required to be modeled.</u>	As proposed <u>Manual blinds or shades shall be modeled the same as in the standard reference design. Automatically controlled blinds or shades shall be modeled.</u>

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.

- b. The combined air exchange rate for infiltration and mechanical ventilation shall be determined in accordance with Equation 43 of 2001 ASHRAE *Handbook of Fundamentals*, page 26.24 and the "Whole-house Ventilation" provisions of 2001 ASHRAE *Handbook of Fundamentals*, page 26.19 for intermittent mechanical ventilation.
- 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: The IECC is not currently clear on how manual or automated shades and blinds are to be addressed in the performance path, other than specifying an interior shade fraction. This could lead to potential gaming using different assumptions for shading in the reference and proposed designs, so should be clarified. First, this proposal specifies that manual blinds and shades are to be modeled the same in the reference and proposed designs. This ensures manual shades are treated neutrally, with no credit for manual shades since occupant behavior and the performance of manual controls cannot be guaranteed. Second, it does allow automatically controlled shades to be modeled in the proposed building, as this can provide advanced energy performance without relying on an occupant's behavior. To avoid proprietary issues, the control scheme for how the automated shades are modeled is not specified and is left up to the designer or builder, subject to approval by the code official. This is similar to how automated shades are already addressed in ASHRAE 90.1 for commercial applications, and a similar proposal has been submitted for the commercial IECC.

Cost Impact: The code change proposal will not increase or decrease the cost of construction. This change simply clarifies how manual and automated blinds and shades are to be addressed in the performance path, and does not impact cost of construction.

Proposal # 4985

CE248-19 Part II

CE249-19

IECC: C408.3.1

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

2018 International Energy Conservation Code

Revise as follows:

C408.3.1 Functional testing. Prior to passing final inspection, the registered design professional or approved agency shall provide evidence that the lighting control systems have been tested to ensure that control hardware and software are calibrated, adjusted, programmed and in proper working condition in accordance with the construction documents and manufacturer's instructions. Functional testing shall be in accordance with Sections C408.3.1.1 through C408.3.1.3 for the applicable control type.

Reason: The addition of 'or approved agency' will make the lighting systems requirements match the mechanical system requirements in C 408.2.1. This will facilitate and add flexibility to the enforcement of the commissioning requirements.

Cost Impact: The code change proposal will not increase or decrease the cost of construction. This proposal does not change the underlying requirements of the Code but simply adds clarifying language that aligns the Lighting Commissioning requirements with those of the mechanical requirements such that a qualified Commissioning professional can perform the Commissioning activities in addition to the previously singularly called out design professional.

Proposal # 4590

CE249-19

CE250-19

IECC: SECTION C501, C501.1, C501.2, C501.4, SECTION C502, C502.1, C503.2, C502.2, C502.2.1, C502.2.2, C502.2.3, C502.2.6, C502.2.6.1, C502.2.6.2, SECTION C503, C503.1, C503.4, C503.5, C503.6

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

2018 International Energy Conservation Code

SECTION C501 GENERAL

Revise as follows:

C501.1 Scope. The provisions of this chapter shall control the alteration, repair, addition and change of occupancy of existing buildings and structures.

~~C501.2~~ **C501.1.1 Existing buildings.** 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.

~~C501.4~~ **C501.2 Compliance.** ~~Alterations, Additions, alterations, repairs, additions and changes of occupancy to, or relocation of, existing buildings and structures shall comply Sections C502, C503, C504, or C505 of this code, and with the provisions for alterations, repairs, additions and changes of occupancy or relocation, respectively, in this code and in the International Building Code , International Existing Building Code , International Fire Code , International Fuel Gas Code , International Mechanical Code , International Plumbing Code , International Property Maintenance Code , International Private Sewage Disposal Code and NFPA 70. Changes where unconditioned space is changed to conditioned space shall comply with Section C502.~~

Exception: Additions, alterations, repairs, or changes of occupancy complying with ANSI/ASHRAE/IESNA 90.1

SECTION C502 ADDITIONS

C502.1 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 if the addition alone complies or if the existing building and addition comply with this code as a single building. ~~Additions shall comply with Sections C402, C403, C404, C405 and C502.2. Additions complying with ANSI/ASHRAE/IESNA 90.1, need not comply with Sections C402, C403, C404 and C405.~~

~~C503.2~~ **C502.2 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.~~ comply with Section C502.

Exceptions:

1. Where the component performance alternative in Section C402.1.5 is used to comply with this section, the proposed UA shall be not greater than 110 percent of the target UA.

2. Where the total building performance option in Section C407 is used to comply with this section, the annual energy cost of the proposed design shall be not greater than 110 percent of the annual energy cost otherwise permitted by Section C407.3.

~~C502.2 C502.3 Prescriptive compliance. Compliance.~~ Additions shall comply with Sections ~~C502.2.1 C502.3.1~~ through ~~C502.2.6.2 C502.3.6.2~~.

~~C502.2.1 C502.3.1 Vertical fenestration: fenestration area.~~ Additions shall comply in accordance with the following:

New

1. ~~Where an addition has new~~ vertical fenestration area that results in a total building fenestration area less than or equal to that ~~specified in permitted by~~ Section C402.4.1 ~~the addition~~ shall comply with Section C402.1.5, C402.4.3 or C407.
2. ~~Additions~~ ~~Where an additions~~ with vertical fenestration that ~~result results~~ in a total building fenestration area greater than Section C402.4.1 or additions that exceed the fenestration area greater than ~~that permitted by~~ Section C402.4.1 ~~the fenestration~~ shall comply with Section C402.4.1.1 for the addition only. ~~Additions that result~~
3. ~~Where an addition has vertical fenestration that results~~ in a total building vertical fenestration area exceeding that ~~specified in permitted by~~ Section C402.4.1.1 ~~the addition~~ shall comply with Section C402.1.5 or C407.

~~C502.2.2 C502.3.2 Skylight area.~~ Skylights shall comply as follows:

1. ~~Where an addition has new~~ skylight area that results in a total building fenestration area less than or equal to that ~~specified in permitted by~~ Section C402.4.1, ~~the addition~~ shall comply with Section C402.1.5 or C407.
2. ~~Additions with~~ ~~Where an addition has new~~ skylight area that ~~result results~~ in a total building skylight area greater than ~~permitted by~~ C402.4.1 or ~~where additions that exceed have skylight area greater than that permitted by C402.4.1,~~ the skylight area shall comply with Section C402.4.1.2 for the addition only.
3. ~~Additions that result~~ ~~Where an addition has skylight area that results~~ in a total building skylight area exceeding that specified in ~~permitted by~~ Section C402.4.1.2, ~~the addition~~ shall comply with Section C402.1.5 or C407.

~~C502.2.3 C502.3.3 Building mechanical systems.~~ New mechanical systems and equipment that are part of the addition and serve the building heating, cooling and ventilation needs shall comply with ~~Section Sections~~ C403, ~~and C408~~.

C502.2.6 Lighting power and systems. New lighting systems that are installed as part of the addition shall comply with ~~Section Sections~~ C405 ~~and C408~~.

C502.2.6.1 Interior lighting power. The total interior lighting power for the addition shall comply with Section C405.3.2 for the addition alone, or the existing building and the addition shall comply as a single building.

C502.2.6.2 Exterior lighting power. The total exterior lighting power for the addition shall comply with Section C405.4.2 for the addition alone, or the existing building and the addition shall comply as a single building.

SECTION C503 ALTERATIONS

C503.1 General. Alterations to any building or structure shall comply with the requirements of Section C503 and 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~~.

alteration. Alterations 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 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 complying with ANSI/ASHRAE/IESNA 90.1, need not comply with Sections C402, C403, C404 and C405.~~

Exception: The following alterations need not 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~~, fenestration.
2. Surface-applied window film installed on existing single-pane fenestration assemblies reducing solar heat gain, provided that the code does not require the glazing or fenestration to be replaced.
3. Existing ceiling, wall or floor cavities exposed during construction, provided that these cavities are filled with insulation.
4. Construction where the existing roof, wall or floor cavity is not exposed.
5. Roof ~~recover~~, recover.
6. Air barriers shall not be required for roof recover and roof replacement where the alterations or renovations to the building do not include alterations, renovations or repairs to the remainder of the building envelope.

C503.4 Heating and cooling systems. New heating, cooling and duct systems that are part of the alteration shall comply with Sections C403 and C408.

C503.5 Service hot water systems. New service hot water systems that are part of the alteration shall comply with ~~Section~~ Sections C404, and C408.

C503.6 Lighting systems. New lighting systems that are part of the alteration shall comply with Section C405 and C408.

Exception. Alterations that replace less than 10 percent of the luminaires in a space, provided that such alterations do not increase the installed interior lighting power.

Reason: No technical changes are intended. 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.

The "Compliance" is relocated from Sec. 501.4 to Sec. 501.2 as more proper code formatting; compliance immediately following scope.

The exception for the 90.1 compliance option applicable to additions and alterations is located under the relocated compliance section

This change clarifies:

- That changes from unconditioned space to condition space must comply as an addition.
- Vertical fenestration and skylight requirements for additions by putting the requirements into a list format for easier reading
- That the IECC and ASHRAE compliance paths cannot be combined.
- That new mechanical, service water, and lighting systems are subject to Section 408 (as per C401.2, requirements for prescriptive and total building performance compliance paths)

“Prescriptive” is stricken from the title of Section 502.2 as it is a misnomer since the section references the performance path as a compliance option.

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>

(<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 does not change the design or construction requirements for a project.

Proposal # 4746

CE250-19

CE251-19

IECC: C502.2.3.1 (New), C502.2.4.1 (New), C502.2.6.3 (New)

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

2018 International Energy Conservation Code

Add new text as follows:

C502.2.3.1 Mechanical systems acceptance testing. New mechanical systems that serve alterations shall comply with Sections C408.2.2, C408.2.3 and C408.2.5.

Exceptions: The following systems are exempt:

1. Mechanical systems and service water heater systems in buildings where the total mechanical equipment capacity is less than 480,000 Btu/h (140.7 kW) cooling capacity and 600,000 Btu/h (175.8 kW) combined service water-heating and space-heating capacity.
2. Systems included in Section C403.5 that serve individual dwelling units and sleeping units

C502.2.4.1 Service hot water systems acceptance testing. New service hot water systems that serve additions shall comply with Sections C408.2.3 and C408.2.5

Exceptions: The following systems are exempt:

1. Service water heater systems in buildings where the total mechanical equipment capacity is less than 600,000 Btu/h (175.8 kW) combined service water-heating and space-heating capacity.
2. Systems included in Section C403.5 that serve individual dwelling units and sleeping units.

C502.2.6.3 Lighting acceptance testing. New lighting systems that serve additions shall comply with Section C408.3.

Reason: Due to the way that the charging language in the IECC is structured, new mechanical, water heating and lighting systems in additions do not need to meet the commissioning / acceptance testing requirements that the same systems in new construction would need to meet. This allows new systems in additions to go without this vital installation step and leaves them vulnerable to poor performance from installation. This proposal closes that loophole.

The proposal includes specific references to the appropriate commissioning /acceptance testing requirements in section C408:

- The balancing (C408.2.2), functional testing (C408.2.3) and documentation (C408.2.5) requirements for HVAC systems.
- The functional testing (C408.2.3) and documentation (C408.2.5) requirements for water heating systems
- The functional testing, documentation and reporting requirements for lighting (C408.3).

It repeats the system-size thresholds in the charging language in C408. The proposal also does not include references to the commissioning plan requirement (C408.2.1) for HVAC equipment. In this way, it has the same scope as the requirements for new construction. Since it references only new equipment in the addition itself, it avoids potentially requiring changes to the existing building systems.

Cost Impact: The code change proposal will increase the cost of construction
The proposal will increase the cost of construction. However, these requirements have already been found to be sufficiently cost effective to be included in the code for new construction.

Proposal # 5172

CE251-19

CE252-19

IECC: C503.1

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:

C503.1 General. Alterations to any building or structure shall comply with the requirements of Section C503 and 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 those provisions 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 complying with ANSI/ASHRAE/IESNA 90.1. need not comply with Sections C402, C403, C404 and C405.

Exception: The following alterations need not 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. Surface-applied window film installed on existing single-pane fenestration assemblies reducing solar heat gain, provided that the code does not require the glazing or fenestration to be replaced.
3. Existing ceiling, wall or floor cavities exposed during construction, provided that these cavities are filled with insulation.
4. Construction where the existing roof, wall or floor cavity is not exposed.
5. Roof recover.
6. Removal and replacement of a roof membrane where there is existing roof insulation integral to or below the roof deck.
7. Air barriers shall not be required for roof recover and roof replacement where the alterations or renovations to the building do not include alterations, renovations or repairs to the remainder of the building envelope.

Reason: The intent of this proposal is to provide clarity and consistency in the IECC with ASHRAE Standard 90.1-2016, Section 5.1.3, Exception 6.

Bibliography: ASHRAE 90.1—2016: Energy Standard for Buildings Except Low-rise Residential Buildings ... In 2018 IECC Sections ... C401.2, Table C402.1.3, Table C402.1.4, C406.2, Table C407.6.1, C502.1, C503.1, C504.1

Cost Impact: The code change proposal will decrease the cost of construction. This change better positions the IECC to be clearer, more easily applied to removal and replacement operations, and competitive with the 90.1 Standard alternative; thereby no cost impact when compared with current provisions.

Proposal # 5257

CE253-19 Part I

PART I — IECC: C503.1

PART II — IECC: R503.1.1 (IRC N1109.1.1)

Proponent: William McHugh, The McHugh Company, representing Chicago Roofing Contractors Association (billmchugh-jr@att.net)

2018 International Energy Conservation Code

Revise as follows:

C503.1 General. *Alterations* to any *building* or structure shall comply with the requirements of Section C503 and 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 those provisions 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 complying with ANSI/ASHRAE/IESNA 90.1. need not comply with Sections C402, C403, C404 and C405.

Exception: The following *alterations* need not 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. Surface-applied window film installed on existing single-pane *fenestration* assemblies reducing solar heat gain, provided that the code does not require the glazing or *fenestration* to be replaced.
3. Existing ceiling, wall or floor cavities exposed during construction, provided that these cavities are filled with insulation.
4. Construction where the existing roof, wall or floor cavity is not exposed.
5. *Roof recover*.
6. *Air barriers* shall not be required for *roof recover* and roof replacement where the *alterations* or renovations to the building do not include *alterations*, renovations or *repairs* to the remainder of the building envelope.
7. . Roof replacements for roof systems less than 2:12 slope shall comply with the low slope roofing insulation requirements for new construction unless the installation of insulation above the structural roof deck necessary to achieve the code required R-value is deemed infeasible by the code official to accommodate the added thickness of insulation above the roof deck. Conditions of infeasibility include but are not limited to flashing height limitations at HVAC, equipment or skylight curbs, low door or glazing heights above the roof surface, parapet, weep holes, drainage patterns or due to cricket or saddle construction, subject to manufacturers installation instructions and code official approval.

Proposal # 5339

CE253-19 Part I

CE253-19 Part II

IECC: R503.1.1 (IRC N1109.1.1)

Proponent: William McHugh, The McHugh Company, representing Chicago Roofing Contractors Association (billmchugh-jr@att.net)

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.
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.
7. Roof replacements for roof systems less than 2:12 slope shall comply with the low slope roofing insulation requirements for new construction unless the installation of insulation above the structural roof deck necessary to achieve the code required R-value is deemed infeasible by the code official to accommodate the added thickness of insulation above the roof deck. Conditions of infeasibility include but are not limited to flashing height limitations at HVAC, equipment or skylight curbs, low door or glazing heights above the roof surface, parapet, weep holes, drainage patterns or due to cricket or saddle construction, subject to manufacturers installation instructions and code official approval.

Reason: The reason for this code proposal is to give code officials that use the International Energy Conservation Code the guidance for when flashing heights are not tall enough to accommodate the use of new construction insulation thicknesses. The IECC's 503.1 General speaks to the code official, roofing industry and building owner and manager through

R503.1 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.

This 503.1 General Section, as bolded, clearly states that the building is not to be less conforming than it was before the alteration - it even says it twice. It is especially true of roofing work where the scope of work is to keep the building dry. Just because the insulation is exposed does not mean that the rooftop needs to be rebuilt to accommodate new construction insulation thicknesses.

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

The code change proposal will decrease the cost of construction. This option, if it becomes part of the IECC, will allow the building owner to not have to raise HVAC units, equipment, roof perimeter nailers, parapet walls, replace doors and windows that are not high enough to accommodate the insulation, stack vents, etc., as would occur on a low sloped residential structure. This action results in cost savings, allowed in the code.

Proposal # 5344

CE253-19 Part II

CE254-19

IECC: C503.1

Proponent: Glenn Heinmiller, Lam Partners, representing International Association of Lighting Designers (glenn@lampartners.com); Jack Bailey (jbailey@oneluxstudio.com)

2018 International Energy Conservation Code

Revise as follows:

C503.1 General. Alterations to any building or structure shall comply with the requirements of Section C503, and Sections C402, C403, C404, C405 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 those provisions 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 complying with ANSI/ASHRAE/IESNA 90.1. need not comply with Sections C402, C403, C404 and C405.

Exception: The following alterations need not 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. Surface-applied window film installed on existing single-pane fenestration assemblies reducing solar heat gain, provided that the code does not require the glazing or fenestration to be replaced.
3. Existing ceiling, wall or floor cavities exposed during construction, provided that these cavities are filled with insulation.
4. Construction where the existing roof, wall or floor cavity is not exposed.
5. Roof recover.
6. Air barriers shall not be required for roof recover and roof replacement where the alterations or renovations to the building do not include alterations, renovations or repairs to the remainder of the building envelope.

Reason: This revision makes it clear what portions of “the code for new construction” apply to Alterations, and specifically that C406 does not apply to Alterations. We believe that this is the original intent of the code and that this proposal fixes an editorial omission.

This change matches the approach already used in C502.1 for Additions. C502.1 does *not* require compliance with C406.

C406 Additional Efficiency Package Options cannot be required of Additions and Alterations. Most of the options only apply to the construction of new buildings and are not typically possible to achieve for Alteration or Addition projects.

Cost Impact: The code change proposal will not increase or decrease the cost of construction. This proposal is an editorial clarification.

Proposal # 4596

CE254-19

CE255-19 Part I

PART I — IECC: C202, C503.1

PART II — IECC: R202 (N1101.6) , R503.1.1 (IRC N1109.1.1)

Proponent: Bill McHugh, The McHugh Company, representing Chicago Roofing Contractors Association (bill@mc-hugh.us)

2018 International Energy Conservation Code

Add new definition as follows:

ROOF MEMBRANE PEEL AND REPLACEMENT. Where an existing roof membrane alone is removed, exposing insulation or sheathing, and only a new weather resisting roof membrane is installed.

Revise as follows:

C503.1 General. *Alterations* to any *building* or structure shall comply with the requirements of Section C503 and 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 those provisions 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* complying with ANSI/ASHRAE/IESNA 90.1. need not comply with Sections C402, C403, C404 and C405.

Exception: The following *alterations* need not 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. Surface-applied window film installed on existing single-pane *fenestration* assemblies reducing solar heat gain, provided that the code does not require the glazing or *fenestration* to be replaced.
3. Existing ceiling, wall or floor cavities exposed during construction, provided that these cavities are filled with insulation.
4. Construction where the existing roof, wall or floor cavity is not exposed.
5. *Roof recover*.
6. *Air barriers* shall not be required for *roof recover* and roof replacement where the *alterations* or renovations to the building do not include *alterations*, renovations or *repairs* to the remainder of the building envelope.
7. . Roof membrane peel and replacement.

Proposal # 5334

CE255-19 Part I

CE255-19 Part II

IECC: R202 (N1101.6) , R503.1.1 (IRC N1109.1.1)

Proponent: William McHugh, The McHugh Company, representing Chicago Roofing Contractors Association (billmchugh-jr@att.net)

2018 International Energy Conservation Code

SECTION R202 (IRC N1101.6) GENERAL DEFINITIONS

Add new definition as follows:

ROOF MEMBRANE PEEL AND REPLACEMENT. Where an existing roof membrane alone is removed, exposing insulation or sheathing, and only a new weather resisting roof membrane is installed.

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.
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.
7. Roof membrane peel and replacement.

Reason: This new definition and accompanying technical requirement adds a subset of the Roof Recover operation to the International Energy Conservation Code. The operation means that the building owner and manager can re-use the existing insulation providing sustainability to the insulation products in place. The operation provides the building owner and manager with a code approved, economical option that does not increase the energy use of existing buildings, meeting the bolded intent of the 503.1 General Section of the IECC.

For convenience, the C503.1 General section is below, bolded for emphasis:

C503.1 General. Alterations to any building or structure shall comply with the requirements of Section C503 and 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 those provisions 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.

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

The code change proposal will decrease the cost of construction. This type of re-roofing operation is where the roof covering membrane is peeled off, and a new roof covering membrane installed over a prepared surface. This operation is not currently allowed by the International Energy Conservation Code. If allowed, Roof Membrane Peel and Replacement will decrease the cost of construction because the operation does not trigger meeting the minimum R-30 c.i. insulation requirements for new construction, as it would today. The operation does not increase the energy usage of the building, consistent with Section C503.1 General's statements, of the IECC.

Proposal # 5363

CE255-19 Part II

CE256-19

IECC: C503.3.1

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:

C503.3.1 Roof replacement. Roof replacements shall comply with Section C402.1.3, C402.1.4, C402.1.5 or C407 where the existing roof assembly is part of the building thermal envelope and contains insulation entirely above the roof deck.

Exception: Where the required R-value cannot be provided due to above-deck thickness limitations presented by existing rooftop conditions, including an HVAC system or refrigeration equipment, skylight curbs, 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.

Reason: This proposal is CE287-16 resubmitted with the sole difference clarifying “above-deck” thickness and adding “*approved*.” 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 C402.1.3 or Table C402.1.4. Consider the sheer square footage of buildings 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 C505.1, 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 the newly proposed Exception is a “do-no-harm” proposition.

The proposed exception is a pragmatic and constructible solution taken nearly word-for-word from the 2015 IgCC, Section 1003.2.7—Roof Replacement Insulation. We believe the proposal makes clear that the maximum thickness of insulation compatible within the technically-feasible limitations of available space is 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 # 5296

CE256-19

CE257-19

IECC: SECTION C503, C503.3.1

Proponent: Wanda Edwards, Wanda Edwards Consulting, Inc., representing RCI, Inc. (wedwards@rci-online.org)

2018 International Energy Conservation Code

SECTION C503 ALTERATIONS

Revise as follows:

C503.3.1 Roof replacement. *Roof replacements* shall comply with Section C402.1.3, C402.1.4, C402.1.5 or C407 where the existing roof assembly is part of the *building thermal envelope* and contains insulation entirely above the roof deck.

Exception: Where approved by the code official, the required R-value cannot be provided because of the thickness limitations presented by existing rooftop conditions, including heating, ventilating and air conditioning equipment, low door or glazing heights, parapet heights and roof flashing heights, the maximum thickness of insulation compatible with the available space and existing uses shall be installed.

Reason: Occasionally, the installation of additional insulation can be technically infeasible. For instance, adding insulation can block windows on adjacent walls, entrances on and off the roof can have the height of the opening lessened by adding insulation. Take for an example an existing roof with internal drainage system. If the drains are 60 feet apart, the maximum depth of insulation with be 30 feet from the drain. If the insulation slopes at the minimum required slope of 1/4" inch per foot, the insulation depth with be 7.5 inches thirty feet from the drain. This proposal would require that the code official confirm that the addition of the insulation is technically infeasible to ensure this provision is utilized only when approved by the code official, and not when the contractor or designer determines it technically infeasible and ensure the provision is used properly.

Cost Impact: The code change proposal will decrease the cost of construction
This proposal would decrease the cost of construction when it is determined that it is technically infeasible to add insulation above the roof deck.

Proposal # 5591

CE257-19

CE258-19

IECC: C503.3.1

Proponent: David Renn, PE, SE, City and County of Denver, representing Code Change Committee of Colorado Chapter of ICC (david.renn@denvergov.org)

2018 International Energy Conservation Code

Revise as follows:

C503.3.1 Roof replacement. *Roof replacements* shall comply with Section C402.1.3, C402.1.4, C402.1.5 or C407 where the existing roof assembly is part of the *building thermal envelope* and contains insulation entirely above the roof deck. In no case shall the *R-value* of the roof insulation be reduced or the *U-factor* of the roof assembly be increased as part of the *roof replacement*.

Reason: Where roof replacements must comply with thermal envelope requirements of new construction, the code currently allows the use of one of 4 different compliance methods. Depending on the compliance method used, it may not be compatible with the original design of the building thermal envelope and may actually allow a reduction in roof insulation. For example, if a building was designed using the Total Building Performance method (C407), the roof insulation may have been increased to be above prescriptive requirements to allow less insulation in the walls. A roof replacement could then use the prescriptive requirements (C402.1.3 or C402.1.4) of the current code, which may require less insulation than the original design. To eliminate the potential of a reduction in performance of the entire thermal envelope, this proposal requires that the roof insulation not be reduced during a roof replacement, even if a different compliance path is used.

Cost Impact: The code change proposal will not increase or decrease the cost of construction. This proposal fixes a potential loophole in the current code that rarely would occur, so cost of construction would typically not increase or decrease. There would be a cost of construction increase if the current loophole was used to reduce the amount of insulation that is provided in a roof replacement, but likelihood of this occurring is rare.

Proposal # 4154

CE258-19

CE259-19

IECC: C503.3.2, C401.2.1

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:

C503.3.2 Vertical fenestration. The addition of vertical fenestration that results in a total building fenestration area less than or equal to that specified in Section C402.4.1 shall comply with Section C402.1.5, C402.4.3 or C407. The addition of vertical fenestration that results in a total building fenestration area greater than Section C402.4.1 shall comply with Section C402.4.1.1 for the space adjacent to the new fenestration only. Alterations that result in a total building vertical fenestration area exceeding that specified in Section C402.4.1.1 shall comply with Section C402.1.5 or C407. Provided that the vertical fenestration area is not changed, using the same vertical fenestration area in the standard reference design as the building prior to alteration shall be an alternative to using the vertical fenestration area specified in Table C407.5.1(1).

~~C401.2.1~~ C503.3.2.1 Application to replacement Replacement fenestration products. 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 in Table C402.4.

Exception: An area-weighted average of the *U*-factor of replacement fenestration products being installed in the building for each fenestration product category listed in Table C402.4 shall be permitted to satisfy the *U*-factor requirements for each fenestration product category listed in Table C402.4. Individual fenestration products from different product categories listed in Table C402.4 shall not be combined in calculating the area-weighted average *U*-factor.

Reason: Moving fenestration replacement to Chapter 5 properly co-locates the provisions for fenestration changes in existing buildings.

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>
(<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 change does not increase or decrease code provisions nor impact construction methods. It clarifies language and provisions already contained in the code.

Proposal # 4176

CE259-19

CE260-19

IECC: C503.4.2 (New), C503.5.1 (New), C503.6.1 (New)

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

2018 International Energy Conservation Code

Add new text as follows:

C503.4.2 Mechanical system acceptance testing. New mechanical systems that serve alterations shall comply with Sections C408.2.2, C408.2.3 and C408.2.5.

Exceptions:

1. Mechanical systems and service water heater systems in buildings where the total mechanical equipment capacity is less than 480,000 Btu/h (140.7 kW) cooling capacity and 600,000 Btu/h (175.8 kW) combined service water-heating and space-heating capacity.
2. Systems included in Section C403.5 that serve individual dwelling units and sleeping units

C503.5.1 Service hot water system acceptance testing. New service hot water systems that serve alterations shall comply with Sections C408.2.3 and C408.2.5.

Exceptions:

1. Service water heater systems in buildings where the total mechanical equipment capacity is less than 600,000 Btu/h (175.8 kW) combined service water-heating and space-heating capacity.
2. Systems included in Section C403.5 that serve individual dwelling units and sleeping units.

C503.6.1 Lighting acceptance testing. New lighting systems that serve alterations shall comply with Section C408.3.

Reason: Due to the way that the charging language in the IECC is structured, new mechanical, water heating and lighting systems in alterations do not need to meet the commissioning / acceptance testing requirements that the same systems in new construction would need to meet. This allows new systems in alterations to go without this vital installation step and leaves them vulnerable to poor performance from installation. This proposal closes that loophole.

The proposal includes specific references to the appropriate commissioning /acceptance testing requirements in section C408:

- The balancing (C408.2.2), functional testing (C408.2.3) and documentation (C408.2.5) requirements for HVAC systems.
- The functional testing (C408.2.3) and documentation (C408.2.5) requirements for water heating systems
- The functional testing, documentation and reporting requirements for lighting (C408.3).

It repeats the system-size thresholds in the charging language in C408. In this way, it has the same scope as the requirements for new construction. Since it references only new equipment in alterations, it avoids potentially requiring changes to the existing building systems. The proposal does not include references to the commissioning plan requirement (C408.2.1) for HVAC equipment.

Cost Impact: The code change proposal will increase the cost of construction
The proposal will increase the cost of construction. However, these requirements have already been found to be sufficiently cost effective to be included in the code for new construction.

Proposal # 5171

CE260-19

CE261-19

IECC: 202 (New), SECTION C505, C505.1, C505.1.1 (New), C505.1.2 (New), C505.2 (New), C505.2.1 (New), C505.2.2 (New), C505.2.3 (New), C505.2.4 (New), TABLE C505.2.2 (New), TABLE C505.2.3 (New), TABLE C505.2.4 (New)

Proponent: David Collins, representing SEHPCAC (sehpcac@iccsafe.org); Maureen Guttman, representing BCAP-IBTS (mguttpgh@aol.com); David Collins, representing The American Institute of Architects (dcollins@preview-group.com)

2018 International Energy Conservation Code

Add new definition as follows:

ENERGY USE INTENSITY (EUI). The metric indicating the total amount of energy consumed by a building in one year divided by the total gross floor area of the building.

SECTION C505 CHANGE OF OCCUPANCY OR USE

C505.1 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. Where the use in a space changes from one use in Table C405.3.2(1) or C405.3.2(2) to another use in Table C405.3.2(1) or C405.3.2(2), the installed lighting wattage shall comply with Section C405.3. Where the space undergoing a change in occupancy or use is in a building with a fenestration area that exceeds the limitations of Section C402.4.1, the space is exempt from Section C402.4.1 provided that there is not an increase in fenestration area.~~

Exceptions:

from F, H or U occupancy classification shall comply with Section C503. Buildings or portions of buildings undergoing a change of occupancy without alterations shall comply with Section C502.2

Exceptions:

- ~~1. Where the component performance alternative in Section C402.1.5 is used to comply with this section, the proposed UA shall be not greater than 110 percent of the target UA.~~
- ~~2. Where the total building performance option in Section C407 is used to comply with this section, the annual energy cost of the proposed design shall be not greater than 110 percent of the annual energy cost otherwise permitted by Section C407.3.~~

Add new text as follows:

C505.1.1 Alterations and change of occupancy Alterations made concurrently with any change of occupancy shall be in accordance with Section C503.

C505.1.2 Portions of buildings Where changes in occupancy and use are made to portions of an existing building, only those portions of the building shall comply with Section C505.2.

C505.2 Energy Use Intensities Building envelope, space heating, cooling, ventilation, lighting and service water heating shall comply with Sections C505.2.1 through C505.2.4.

Exceptions:

1. Where it is demonstrated by analysis approved by the code official that the change will not increase energy

use intensity.

2. Where the occupancy or use change is less than 5,000 square feet in area.

C505.2.1 Building Envelope Where a change of occupancy or use is made to a whole building that exceeds the maximum fenestration area allowed by Section C402.4.1, the building shall comply with Section C402.1.5, with a proposed UA that shall not be greater than 110 percent of the target UA.

Exception:

Where the change of occupancy or use is made to a portion of the building, the new occupancy is exempt from Section C402.4.1 provided that there is not an increase in fenestration area.

C505.2.2 Building Mechanical Systems Where a change of occupancy or use results in the same or increased energy use intensity rank as specified in Table C505.2.2, the systems serving the building or space undergoing the change shall comply with Section C403.

C505.2.3 Service Water Heating Where a change of occupancy or use results in the same or increased energy use intensity rank as specified in Table C505.2.3, the service water heating systems serving the building or space undergoing the change shall comply with Section C404.

C505.2.4 Lighting Where a change of occupancy or use results in the same or increased energy use intensity rank as specified in Table C505.2.4, the lighting systems serving the building or space undergoing the change shall comply with Section C405 except for Sections C405.2.6 and C405.4.

TABLE C505.2.2
Building Mechanical Systems

Energy Use Intensity Rank	International Building Code Occupancy Classification and Use
<u>1. High</u>	<u>A-2, B-Laboratories, I-2</u>
<u>2. Medium</u>	<u>A-1, A-3^a, A-4, A-5, B^b, E, I-1, I-3, I-4, M, R-4</u>
<u>3. Low</u>	<u>A-3-Places of Religious Worship, R-1, R-2, R-3^c, S-1, S-2</u>

a. Excluding places of religious worship.

b. Excluding laboratories.

c. Buildings three stories or less in height above grade plane shall comply with Section R505.

TABLE C505.2.3
Service Water Heating

Energy Use Intensity Rank	International Building Code Occupancy Classification and Use
<u>1. High</u>	<u>A-2, I-1, I-2, R-1</u>
<u>2. Low</u>	<u>All other occupancies and uses</u>

TABLE C505.2.4
Lighting

Energy Use Intensity Rank	International Building Code Occupancy Classification and Use
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1. <u>High</u>	B-Laboratories, B-Outpatient Healthcare, I-2, M
2. <u>Medium</u>	A-2, A-3 Courtrooms, B ^a , I-1, I-3, I-4, R-1, R-2, R-3 ^b , R-4, S-1, S-2
3. <u>Low</u>	A-1, A-3 ^c , A-4, E

a. Excluding laboratories and outpatient healthcare.

b. Buildings three stories or less in height above grade plane shall comply with Section R505.

c. Excluding courtrooms.

Reason: The IECC 2018 change of occupancy requirement (C505.1) begins with this statement:

“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.”

Field research and surveys of building officials demonstrate that this requirement is difficult to enforce (Clinton et al, 2016). One reason for this is that while it is a clear performance requirement, there is no simple compliance evaluation method other than energy modeling, which is beyond the capabilities of most change-of-occupancy permit applicants. As depicted in the referenced survey findings and community-based pilot research, building officials often require energy efficiency equipment upgrades, such as lighting or HVAC, in buildings undergoing a change of occupancy. This proposal seeks to provide clarity to that approach by providing a simple breakdown of energy use intensity (EUI) by building occupancy type and system type.

The proposed code change draws on a tradition of rehabilitation “smart codes” use-based lookup tables, is more consistent with the intent of the IECC, presents no cost increase, and incorporates extensive research and stakeholder input.

This proposal advances the Energy Use Intensity (EUI) as the metric for energy demand and the trigger for code compliance. Historic energy intensity per square foot is recorded for commercial buildings in the *Commercial Buildings Energy Consumption Survey* (CBECS). The CBECS data make it possible to rank building occupancies in the order of the energy intensities. Note that the ranking of occupancies to trigger specific code requirements has been a feature of the *International Existing Building Code* (IEBC) since its earliest editions (see IEBC 2009 Section 912, Change of Occupancy Classification, Tables 912.4, 912.5 and 912.6), and thus is familiar to building code officials.

Energy intensity data in CBECS is further broken down by various end uses (space conditioning, service water heating and lighting) which makes it possible to identify when it is appropriate to trigger code compliance of specific sections of the IECC. For each of these end uses, an increase in intensity triggers compliance with the correlating code provisions related to new construction in Chapter 4. Only an increase in energy intensities in all three of the end uses triggers full compliance with the code.

There are two exceptions that apply to all four end uses, indicated in Section C505.2:

1. Where it is demonstrated by analysis approved by the code official that the change will not increase energy use intensity.
2. Where the occupancy or use change is less than 5,000 square feet in area.

A matrix has been developed for each system end use that groups building occupancy classifications into HIGH, MEDIUM and LOW energy use intensities, measured in annual kBtu/sf. Data for this analysis came from the

U.S. Department of Energy's 2012 CBECS. When occupancy classification or use is being changed from one energy intensity rank to a higher energy use intensity rank (or remains within the same energy use intensity rank), this proposal requires that specific system end-use to comply with the code.

Change of Occupancy Scale - Space Heating, Cooling and Ventilation

EUI Rank	CBECS Building Type	EUI Range kBtu/sq.ft.	IBC Occupancy Classification
1. High	Food Service, Laboratories, Health Care (Inpatient)	> 55	A-2, B-Laboratories, I-2
2. Medium	Public Assembly, Public Order and Safety, Office, Service, Health Care (Outpatient), Education, Retail, Residential Care/Assisted Living	27 - 55	A-1, A-3, A-4, A-5, B, E, I-1, I-3, I-4, M, R-4
3. Low	Religious Worship, Apartments, Warehouse and Storage	<27	A-3 Places of Worship, R-1, R-2, R-3, S-1, S-2

Change of Occupancy Scale - Service Water Heating

EUI Rank	CBECS Building Type	EUI Range kBtu/sq.ft.	IBC Occupancy Classification
1. High	Food Service, Health Care (Inpatient), Residential Care/Assisted Living, Lodging	> 15	A-2, I-1, I-2, R-1
2. Low	All the rest	< 15	All the rest

Change of Occupancy Scale- Lighting

EUI Rank	CBECS Building Type	EUI Range kBtu/sq.ft.	IBC Occupancy Classification
1. High	Laboratories, Health Care (Outpatient), Health Care (Inpatient), Retail	> 11	B-Laboratories, B-Healthcare (Outpatient), I-2, M
2. Medium	Food Service, Office, Health Care (Outpatient), Service, Public Order and Safety, Residential Care/Assisted Living, Lodging, Apartments, Warehouse and Storage	6.5 - 11	A-2, A-3-Courtrooms, B, I-1, I-3, I-4, R-1, R-2, R-3, R-4, S-1, S-2
3. Low	Public Assembly, Religious Worship, Education	< 6.5	A-1, A-3, A-4, E

Occupancy classifications F, H and U are typically not designed primarily for occupant comfort, and are generally classified as low energy use intensity buildings. Thus any change from one of these groups to any other should be required to comply with the provisions under Section C503 Alterations, even if no physical alteration is planned.

Section C505.2.1 Building Envelope is included as a building system, although with different criteria than EUI Intensity. The requirement and exception exist in the 2018 language; they are simply relocated in this proposal.

This code change proposal has been developed with support from the Consortium for Building Energy Innovation (CBEI), a project of the U. S. Department of Energy, and research conducted by Rutgers University

Bibliography: Clinton J. Andrews, David Hattis, David Listokin, Jennifer A. Senick, Gabriel B. Sherman & Jennifer Souder (2016): Energy –Efficient Reuse of Existing Commercial Buildings, *Journal of the American Planning Association*. doi.10.1080/01944363.2015.1134275

Cost Impact: The code change proposal will not increase or decrease the cost of construction. The current code requirements trigger full compliance with the code when there is an increase in energy demand. The proposed code change offers the metric of energy use intensity per square foot per year for measuring energy demand by occupancy. It applies this metric separately to three energy end uses: space conditioning, lighting, and water heating. Therefore, compliance with the code is triggered only for the end uses for which energy intensity is increased.

In most cases, the proposed change triggers partial code compliance, and only rarely will it trigger full code compliance.

Proposal # 4719

CE261-19

CE262-19

IECC: CA103.6, CA103.7 (New), CA103.7

Proponent: jim edelson, representing New Buildings Institute (jim@newbuildings.org)

2018 International Energy Conservation Code

Revise as follows:

CA103.6 Interconnection pathway. Construction documents shall indicate pathways for routing of conduit or piping from the solar-ready zone to the electrical service panel and electrical energy storage system area, or service hot water system.

Add new text as follows:

CA103.7 Electrical energy storage system-ready area. The floor area of the electrical energy storage system-ready area shall be not less than 2 feet in one dimension and 4 feet in another dimension, and located in accordance with Section 1206.2.8 of the *International Fire Code*. The location and layout diagram of the electrical energy storage system-ready area shall be indicated on the construction documents.

Revise as follows:

~~CA103.7~~ **CA103.8 Electrical service reserved space.** The main electrical service panel shall have a reserved space to allow installation of a dual-pole circuit breaker for future solar electric ~~installation~~ and a dual-pole circuit breaker for future electrical energy storage system installation ~~These spaces~~ shall be labeled "For Future Solar Electric and Storage." The reserved ~~space spaces~~ shall be positioned at the end of the panel that is opposite from the panel supply conductor connection.

Reason: Appendix CA in IECC-commercial and Appendix RB in IECC-residential have proven useful for jurisdictions seeking to add solar ready provisions to state or local codes. As many jurisdictions in which the appendices are being considered are also facing current or future constraints on electric grid capacity to accomodate existing and new distributed solar generation resources, policy objectives are emerging to support the storage of energy produced by solar panels and shift its temporal impact on the grid. This proposal modifies Appenidx CA provisions to ensure that there is design and space consideration for a standard sized battery rack, and for the connections to the electrical panels. As with the rationale for solar-ready, it is generally much more cost-effective at the time of new construction to design for future installation of this equipment than it is to retrofit later in the building's life.

The proposed language also cites the IFC to ensure there is sufficient clearance around the battery rack to meet life/safety concerns. The IFC is already referenced in Chapter 6.

Cost Impact: The code change proposal will increase the cost of construction. The cost impacts are limited to additional design professional fees, to markings on the panels, and to additional construction costs only if there were not spare square footage available in the equipment or storage rooms where panels are generally located. In that case, it would be equal to the construction costs for an additional 8 square feet of storage space.

Proposal # 4965

CE262-19

CE263-19 Part I

PART I — IECC: Appendix CB (New)

PART II — IECC: Appendix RB (New)

PART III — IRC: Appendix U (New)

Proponent: Joseph H. Cain, Solar Energy Industries Association (SEIA), representing Solar Energy Industries Association (SEIA) (JoeCainPE@gmail.com)

THIS IS A 3 PART CODE CHANGE PROPOSAL. PART I WILL BE HEARD BY IECC-CE COMMITTEE. PARTS II and III WILL BE HEARD BY THE IECC-RE COMMITTEE. SEE THE TENTATIVE HEARING ORDERS FOR THESE COMMITTEES.

2018 International Energy Conservation Code

Add new text as follows:

Appendix CB SOLAR PHOTOVOLTAIC (PV) SYSTEM REQUIRED - COMMERCIAL

SECTION CB101 SCOPE

CB101.1 General. These provisions shall be applicable for newly constructed commercial buildings, or additions larger than 5,000 square feet of gross conditioned floor area to commercial buildings, where solar photovoltaic (PV) systems are required.

SECTION CB102 DEFINITIONS

Revise as follows:

CB102.1 General. The following words and terms shall, for the purposes of this appendix, have the meanings shown herein. Refer to Chapter 2 for general definitions.

Add new text as follows:

COMMUNITY SOLAR FACILITY. A facility that generates electrical energy with a solar photovoltaic system, is qualified as a community energy facility, and allocates bill credits to customers under state and local utility statutes and rules.

SECTION CB103 SOLAR PHOTOVOLTAIC (PV) SYSTEMS

CB103.1 Renewable energy systems. Newly constructed commercial buildings, or additions larger than 5,000 square feet of gross conditioned floor area to commercial buildings, shall have an on-site solar photovoltaic system installed. Photovoltaic (PV) systems shall comply with Sections CB103.2 through CB103.4. The code official is authorized to exempt a covered building from the on-site photovoltaic system requirement or allow an alternative means of compliance under any of the following conditions:

Exceptions:

1. Where the code official determines the building has satisfied the purpose and intent of this provision through the use of alternative on-site renewable energy systems such as wind energy systems.
2. Where the code official determines an on-site or off-site community solar facility is dedicated to the building with a legally binding and executed agreement, in conformance with Section CB103.3.

CB103.2 Photovoltaic (PV) system sizing requirement. Minimum installed capacity of PV systems shall be determined in accordance with this section. The PV system installed nameplate capacity (kW_{DC}) shall be not less than 0.25 times the conditioned floor area ($0.25 \text{ W}_{\text{DC}}$ per square foot). The nameplate PV system size shall be calculated as the sum of each PV module's nameplate output (W_{DC}). For buildings 4 or more stories in height, the conditioned floor area for this calculation shall be based on the largest 3 above-grade stories in the building. Where the on-site renewable energy option in Section C406 is selected, the minimum installed capacity required in this section shall be in addition to that required by Section C406.

CB103.3. Community solar facility Where a community solar facility is used as an alternative to an on-site photovoltaic system, the community solar facility shall provide energy savings benefits directly to the building that would otherwise have been required to have an on-site photovoltaic system. The energy savings benefits shall be allocated from the total resource of the community solar facility in a manner demonstrated to be equivalent to the reductions in energy consumption that would have resulted from the on-site photovoltaic system that is otherwise required. The community solar facility shall provide the required energy savings benefits to the dedicated building for a period not less than twenty years. The energy savings benefits shall not be attributed to other purposes and shall not be transferred to other buildings or property.

CB103.4 Leases and power purchase agreements. On-site photovoltaic systems that are leased by the end-use customer (tenant or owner) or that supply electricity to the end-use customer through a power purchase agreement (PPA) shall be permitted to satisfy the requirement provided the system meets all other requirement criteria.

Proposal # 5658

CE263-19 Part I

CE263-19 Part II

IECC: Appendix RB (New)

Proponent: Joseph Cain, representing Solar Energy Industries Association (SEIA) (JoeCainPE@gmail.com)

2018 International Energy Conservation Code

Add new text as follows:

Appendix RB **SOLAR PHOTOVOLTAIC (PV) SYSTEM REQUIRED**

SECTION RB101 **SCOPE**

RB101.1 General. These provisions shall be applicable for newly constructed *residential buildings* where solar photovoltaic (PV) systems are required.

SECTION RB102 **DEFINITIONS**

RB102.1 General. The following words and terms shall, for the purposes of this appendix, have the meanings shown herein. Refer to Chapter 2 for general definitions.

Add new definition as follows:

COMMUNITY SOLAR FACILITY. A facility that generates electrical energy with a solar photovoltaic system, is qualified as a community energy facility, and allocates bill credits to customers, under state and local utility statutes and rules.

STEEP SLOPE. A roof slope greater than two units vertical in 12 units horizontal (17-percent slope).

Add new text as follows:

SECTION RB103 **SOLAR PHOTOVOLTAIC SYSTEM**

RB103.1 Renewable energy systems. Newly constructed residential buildings shall have an on-site solar photovoltaic (PV) system installed. Photovoltaic systems shall comply with Sections RB103.2 through RB103.6. The code official is authorized to exempt a covered building from the on-site photovoltaic system requirement or allow an alternative means of compliance under any of the following conditions:

Exceptions:

1. Where the code official determines there are practical challenges that cause satisfaction of the requirements to be infeasible. Practical challenges include, but are not limited to, building site location, limited rooftop availability, or shading from nearby structures, topography, or vegetation.
2. Where the code official determines the purpose and intent of this provision is satisfied through the use of alternative on-site renewable energy systems such as wind energy systems.

3. If the code official determines an on-site or off-site community solar facility is dedicated to the building with a legally binding and executed agreement, and is in conformance with Section RB103.5.

RB103.2 Photovoltaic (PV) system sizing requirement. Minimum installed capacity of PV systems shall be determined by using one of the two methods in this section, either prescriptive PV sizing in Section RB103.2.1 or performance PV sizing in Section RB103.2.2. Buildings with *conditioned floor area* of 4,500 square feet or greater shall use the performance PV sizing approach in Section RB103.2.2.

RB103.2.1 Prescriptive PV sizing method. For the prescriptive PV sizing method, the PV system installed nameplate capacity (kW_{DC}) shall be not less than 1.0 times the *conditioned floor area* (1.0 Watts per square foot). The nameplate PV system size shall be calculated as the sum of each PV module's nameplate output (W_{DC}).

RB103.2.2 Performance PV sizing method. For the performance PV sizing method, the PV system shall be sized to meet at least 75 percent of the building's total electrical energy use on an annual basis, including both conditioned and unconditioned space. The minimum PV system size requirement (kW_{DC}) shall be calculated using modeling software or other methods approved by the code official.

RB103.3 Photovoltaic system orientation. Fixed-orientation photovoltaic systems located on *steep sloped* roofs shall be oriented with azimuth of each array between 90 degrees and 300 degrees measured clockwise from true north.

Exception: Photovoltaic systems with one or more arrays oriented outside the prescribed azimuth range when the PV system is modeled using performance PV sizing method in Section RB103.2.2..

RB103.4 Shading. All PV systems shall be designed to meet minimal shading criterion in Section RB103.4.1 or the detailed geometries of PV arrays and obstructions shall be considered in the performance PV sizing method in conformance with Section RB103.4.2.

RB103.4.1 Minimal shading criterion. To comply with minimal shading criterion, a PV array shall be no closer to any shading obstruction than twice the height of the obstruction above the PV array. All obstructions that project above the point on the PV array that is closest to the obstruction shall meet this criterion for the array to be considered minimally shaded.

Exception: Any obstruction located north of all points on the array need not be considered as a shading obstruction...

RB103.4.2 Solar access verification. Where any PV array does not meet the minimal shading criterion of Section RB103.4.1, detailed geometries of the PV array and shading profiles from obstructions shall be considered in the performance PV sizing method. Shading profiles shall be measured with a solar assessment tool or determined from aerial satellite images or other automated resources approved by the code official.

RB103.5 Community solar facility. Where a *community solar facility* is used as an alternative to an on-site photovoltaic system, the *community solar facility* shall provide energy savings benefits directly to the building that would otherwise have been required to have an on-site photovoltaic system. The energy savings benefits shall be allocated from the total resource of the *community solar facility* in a manner demonstrated to be equivalent to the reductions in energy consumption that would have resulted from the on-site photovoltaic system that is otherwise required. The *community solar facility* shall provide the required energy savings benefits to the dedicated *building* for a period not less than twenty years. The energy savings benefits shall not be attributed to other purposes and shall not be transferred to other buildings or property.

SECTION RB104

LEASES AND PURCHASE AGREEMENTS

RB104.1 Leases and power purchase agreements. On-site photovoltaic systems that are leased by the end-use customer (tenant or owner) or that supply electricity to the end-use customer through a power purchase agreement (PPA) shall be permitted to satisfy the requirement provided the system meets all other requirement criteria.

Proposal # 5649

CE263-19 Part II

CE263-19 Part III

IRC: Appendix U (New)

Proponent: Joseph Cain, representing Solar Energy Industries Association (SEIA) (JoeCainPE@gmail.com)

2018 International Residential Code

Add new text as follows:

Appendix U SOLAR PHOTOVOLTAIC (PV) SYSTEM REQUIRED

SECTION AU101 SCOPE

AU101.1 General. These provisions shall be applicable for newly constructed *residential buildings* where solar photovoltaic (PV) systems are required.

SECTION AU102 DEFINITIONS

AU102.1 General. The following words and terms shall, for the purposes of this appendix, have the meanings shown herein. Refer to Chapter 2 for general definitions.

Add new definition as follows:

COMMUNITY SOLAR FACILITY. A facility that generates electrical energy with a solar photovoltaic system, is qualified as a community energy facility, and allocates bill credits to customers, under state and local utility statutes and rules.

STEEP SLOPE. A roof slope greater than two units vertical in 12 units horizontal (17-percent slope).

Add new text as follows:

SECTION AU103 SOLAR PHOTOVOLTAIC SYSTEM

RB103.1 Renewable energy systems. Newly constructed residential buildings shall have an on-site solar photovoltaic (PV) system installed. Photovoltaic systems shall comply with Sections AU103.2 through AU103.6. The code official is authorized to exempt a covered building from the on-site photovoltaic system requirement or allow an alternative means of compliance under any of the following conditions:

Exceptions:

1. Where the code official determines there are practical challenges that cause satisfaction of the requirements to be infeasible. Practical challenges include, but are not limited to, building site location, limited rooftop availability, or shading from nearby structures, topography, or vegetation.
2. Where the code official determines the purpose and intent of this provision is satisfied through the use of alternative on-site renewable energy systems such as wind energy systems.

3. If the code official determines an on-site or off-site community solar facility is dedicated to the building with a legally binding and executed agreement, and is in conformance with Section AU103.5.

AU103.2 Photovoltaic (PV) system sizing requirement. Minimum installed capacity of PV systems shall be determined by using one of the two methods in this section, either prescriptive PV sizing in Section AU103.2.1 or performance PV sizing in Section AU103.2.2. Buildings with *conditioned floor area* of 4,500 square feet or greater shall use the performance PV sizing approach in Section AU103.2.2.

AU103.2.1 Prescriptive PV sizing method. For the prescriptive PV sizing method, the PV system installed nameplate capacity (kW_{DC}) shall be not less than 1.0 times the *conditioned floor area* (1.0 Watts per square foot). The nameplate PV system size shall be calculated as the sum of each PV module's nameplate output (W_{DC}).

AU103.2.2 Performance PV sizing method. For the performance PV sizing method, the PV system shall be sized to meet at least 75 percent of the building's total electrical energy use on an annual basis, including both conditioned and unconditioned space. The minimum PV system size requirement (kW_{DC}) shall be calculated using modeling software or other methods approved by the code official.

AU103.3 Photovoltaic system orientation. Fixed-orientation photovoltaic systems located on *steep sloped* roofs shall be oriented with azimuth of each array between 90 degrees and 300 degrees measured clockwise from true north.

Exception: Photovoltaic systems with one or more arrays oriented outside the prescribed azimuth range when the PV system is modeled using performance PV sizing method in Section AU103.2.2.

AU103.4 Shading. All PV systems shall be designed to meet minimal shading criterion in Section AU103.4.1 or the detailed geometries of PV arrays and obstructions shall be considered in the performance PV sizing method in conformance with Section AU103.4.2.

AU103.4.1 Minimal shading criterion. To comply with minimal shading criterion, a PV array shall be no closer to any shading obstruction than twice the height of the obstruction above the PV array. All obstructions that project above the point on the PV array that is closest to the obstruction shall meet this criterion for the array to be considered minimally shaded.

Exception: Any obstruction located north of all points on the array need not be considered as a shading obstruction.

AU103.4.2 Solar access verification. Where any PV array does not meet the minimal shading criterion of Section AU103.4.1, detailed geometries of the PV array and shading profiles from obstructions shall be considered in the performance PV sizing method. Shading profiles shall be measured with a solar assessment tool or determined from aerial satellite images or other automated resources approved by the code official.

AU103.5 Community solar facility. Where a *community solar facility* is used as an alternative to an on-site photovoltaic system, the *community solar facility* shall provide energy savings benefits directly to the building that would otherwise have been required to have an on-site photovoltaic system. The energy savings benefits shall be allocated from the total resource of the *community solar facility* in a manner demonstrated to be equivalent to the reductions in energy consumption that would have resulted from the on-site photovoltaic system that is otherwise required. The *community solar facility* shall provide the required energy savings benefits to the dedicated *building* for a period not less than twenty years. The energy savings benefits shall not be attributed to other purposes and shall not be transferred to other buildings or property.

SECTION AU104

LEASES AND PURCHASE AGREEMENTS

AU104.1 Leases and power purchase agreements. On-site photovoltaic systems that are leased by the end-use customer (tenant or owner) or that supply electricity to the end-use customer through a power purchase agreement (PPA) shall be permitted to satisfy the requirement provided the system meets all other requirement criteria.

Reason: This proposal provides a new Appendix for the International Residential Code which would be available to jurisdictions wanting to adopt renewable energy requirements for new one- and two family dwellings and townhouse buildings; enabling direct opportunity to meet state RPS goals to incorporate renewable energy. This proposal continues to move renewable energy into mainstream practice for the design and construction industries which will diversify the state and jurisdictional energy portfolio amongst traditional energy resources and new renewable generation via utilities and distributed energy resources. The benefit to the homeowner is lower, more consistent energy bills. This language does not increase enforcement efforts because the review and inspection process for mechanical and renewable energy systems is currently standard practice. This proposal is modeled after the California Energy Commission (CEC) model ordinance language, which is useful to early adopters that want to require PV for new residential buildings in their communities, with a modification to allow jurisdictions flexibility to further customize.

Individual technical provisions of this appendix are also based on 2019 CA Building Energy Efficiency Standards (BEES):

Joint Appendix JA11 -- Qualification Requirements for Photovoltaic System, and

Section 10-115 -- Community Shared Solar Electric Generation System or Community Shared Battery Storage System Compliance Option for Onsite Solar Electric Generation or Battery Storage Requirements.

Cost Impact: The code change proposal will increase the cost of construction. This proposal will increase the first cost of construction for PV systems that are a cash purchase, but not for systems that are under lease agreements or power purchase agreements (PPA's). The installed cost of new PV systems retrofitted on existing homes is approximately \$2.50 per Watt. Greater cost savings can be realized owing to installations on new homes and the efficiencies of repetitive procedures.

Proposal # 5808

CE263-19 Part III

CE264-19

IECC: AX 100 (New), AX101 (New), AX102 (New), AX103 (New), AX104 (New), TABLE AX104.1 (New), AX104.1 (New), AX104.2 (New), AX104.2.1 (New), AX104.2.2 (New), AX104.2.3 (New), TABLE AX104.2 (New)

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

2018 International Energy Conservation Code

Add new text as follows:

AX 100 **ZERO CODE RENEWABLE ENERGY STANDARD**

AX101 PURPOSE The purpose of the Zero Code Renewable Energy Appendix is to supplement the International Energy Conservation Code and require renewable energy systems of adequate capacity to achieve zero-net-carbon.

AX102 SCOPE This appendix applies to new buildings that are addressed by the International Energy Conservation Code.

Exceptions:

1. Single-family houses, multifamily structures of three stories or fewer above grade in height, manufactured homes (mobile homes), and manufactured houses (modular).
2. Buildings that use neither electricity nor fossil fuel.

AX103 Definitions The following definitions supplement or modify the definitions in the International Energy Conservation Code.

ADJUSTED OFF-SITE RENEWABLE ENERGY. The amount of energy production from off-site renewable energy systems that may be used to offset building energy.

BUILDING ENERGY. All energy consumed at the building site as measured at the site boundary. Contributions from on-site or off-site renewable energy systems shall not be considered when determining the building energy.

ENERGY UTILIZATION INTENSITY(EUI). The site energy for either the baseline building or the proposed building divided by the gross conditioned floor area plus any semi-heated floor area of the building. For the baseline building, the EUI can be divided between regulated energy use and unregulated energy use.

RENEWABLE ENERGY SYSTEM. Photovoltaic, solar thermal, geothermal energy, and wind systems used to generate energy.

ON-SITE RENEWABLE ENERGY SYSTEM. Renewable energy systems on the building project.

OFF-SITE RENEWABLE ENERGY SYSTEM. Renewable energy system not located on the building project.

ZERO ENERGY PERFORMANCE INDEX(zEPI_{PB,EE}). The ratio of the proposed building EUI without renewables to the baseline building EUI, expressed as a percentage.

SEMI-HEATED SPACE. An enclosed space within a building that is heated by a heating system whose output capacity is greater than or equal to 3.4 Btu/h*ft² of floor area but is not a conditioned space.

AX104 Minimum renewable energy On-site renewable energy systems shall be installed or off-site renewable energy shall be procured to offset the building energy.

$$[if\ gte\ msEquation\ 12]>RE_{onsite}+RE_{offsite}\hat{=}\%E_{building}$$

where

RE_{onsite} = annual site energy production from on-site renewable energy systems (see Section AX104.2)

$RE_{offsite}$ = adjusted annual site energy production from off-site renewable energy systems that may be credited against building energy use (see Section AX104.3)

$E_{building}$ = building energy use without consideration of renewable energy systems.

When Section C401.2 (2) is used for compliance with the International Energy Conservation Code, building energy shall be determined by multiplying the gross conditioned floor area plus the gross semi-heated floor area of the proposed building by an EUI selected from Table AX104.1. Use a weighted average for mixed-use buildings.

When Section C401.2 (1) or C401.2 (3) is used for compliance with the International Energy Conservation Code, building energy shall be determined from energy simulations.

TABLE AX104.1 ENERGY UTILIZATION INTENSITY FOR BUILDING TYPES AND CLIMATES (kBtu/ft²-Y)

	Climate Zone																
Building Area Type	0A/ 1A	0B/ 1B	2A	2B	3A	3B	3C	4A	4B	4C	5A	5B	5C	6A	6B	7	8
kBtu/ft ² -y																	
Multifamily (R-2)	43	45	41	41	43	42	36	45	43	41	47	46	41	53	48	53	59
Healthcare/hospital (I-2)	119	120	119	113	116	109	106	116	109	106	118	110	105	126	116	131	142
Hotel/motel (R-1)	73	76	73	68	70	67	65	69	66	65	71	68	65	77	72	81	89
Office (B)	31	32	30	29	29	28	25	28	27	25	29	28	25	33	30	32	36
Restaurant (A-2)	389	426	411	408	444	420	395	483	437	457	531	484	484	589	538	644	750
Retail (M)	46	50	45	46	44	44	37	48	44	44	52	50	46	60	52	64	77
School (E)	42	46	42	40	40	39	36	39	40	40	39	43	37	44	40	45	54
Warehouse (S)	9	12	9	11	12	11	10	17	13	14	23	17	15	32	23	32	32
All others	55	58	54	53	53	51	48	54	52	51	57	54	50	63	57	65	73

AX104.1 Calculation of On-Site Renewable Energy The annual energy production from on-site renewable energy systems shall be determined using the PVWatts software or other software approved by the code official.

AX104.2 Off-Site Renewable Energy Off-site energy shall comply with Sections AX104.2.1 and AX104.2.2

AX104.2.1 Qualifying off-site procurement methods. The following are considered qualifying off-site renewable energy procurement methods:

1. Community Renewables: an offsite renewable energy system for which the owner has purchased or leased renewable energy capacity along with other subscribers.
2. Renewable Energy Investment Fund: an entity that installs renewable energy capacity on behalf of the owner.
3. Virtual Power Purchase Agreement: a power purchase agreement for off-site renewable energy where the owner agrees to purchase renewable energy output at a fixed price schedule.
4. Direct Ownership: an offsite renewable energy system owned by the building project owner.
5. Direct Access to Wholesale Market: an agreement between the owner and a renewable energy developer to purchase renewable energy.
6. Green Retail Tariffs: a program by the retail electricity provider to provide 100 percent renewable energy to the owner.
7. Unbundled Renewable Energy Certificates (RECs): certificates purchased by the owner representing the environmental benefits of renewable energy generation that are sold separately from the electric power.

AX104.2.2 Requirements for all procurement methods. The following requirements shall apply to all *off-site renewable energy* procurement methods.

1. The building owner shall sign a legally binding contract to procure qualifying *off-site renewable energy*.
2. The procurement contract shall have duration of not less than 15 years and shall be structured to survive a partial or full transfer of ownership of the property.
3. RECs and other environmental attributes associated with the procured *off-site renewable energy* shall be assigned to the building project for the duration of the contract.
4. The *renewable energy* generating source shall be photovoltaic systems, solar thermal power plants, geothermal power plants, and/or wind turbines.
5. The generation source shall be located where the energy can be delivered to the building site by the same utility or distribution entity; the same ISO or RTO; or within integrated ISOs (electric coordination council).
6. The *off-site renewable energy* producer shall maintain transparent accounting that clearly assigns production to the building. Records on power sent to or purchased by the building shall be retained by the building owner and made available for inspection by the code official upon request.

AX104.2.3 Adjusted Off-Site Renewable Energy. The process for calculating the adjusted *off-site renewable energy* is shown in the following equation:

$$RE_{\text{offsite}} = \sum_{i=1}^n PF_i \hat{RE}_i = PF_1 \hat{RE}_1 + PF_2 \hat{RE}_2 + \dots + PF_n \hat{RE}_n$$

where

RE_{offsite} = Adjusted off-site renewable energy

PF_i = Procurement factor for the i^{th} renewable energy procurement method or class taken from Table AX104.2.

RE_i = Annual energy production for the i^{th} renewable energy procurement method or class

n = The number of renewable energy procurement options or classes considered

TABLE AX104.2 Default Off-Site Renewable Energy Procurement Methods, Classes, and Coefficients

Class	Procurement Factor (PF)	Procurement Options	Additional Requirements (see also Section AX104.2.2)
1	0.75	Community Solar	

REIFs	Entity must be managed to prevent fraud or misuse of funds.		
Virtual PPA			
Self-Owned Off-Site	Provisions shall prevent the generation from being sold separately from the building.		
2	0.55	Green Retail Tariffs	The offering shall not include the purchase of unbundled RECs.
Direct Access	The offering shall not include the purchase of unbundled RECs.		
3	0.20	Unbundled RECs	The vintage of the RECs shall align with building energy use.

Reason: The new appendix deals with renewable energy and creates a path to a Zero energy design approach, similar to the zEPI that is already found in the 2015 IgCC. It is designed to build on top of the IECC which already sets the minimum energy efficiency requirement. By putting this information in an appendix, jurisdictions will have the option of adoption of these provisions in order to establish Zero as the energy target they wish to achieve.

Cost Impact: The code change proposal will decrease the cost of construction. The overall cost of construction and operation of buildings constructed using the Zero Annex will be lower than other comparable buildings.

Proposal # 5356

CE264-19

CE265-19

IECC: (New), C406.1, C406.10 (New)

Proponent: Steven Rosenstock, Edison Electric Institute, representing Edison Electric Institute (srosenstock@eei.org)

2018 International Energy Conservation Code

Add new definition as follows:

ENERGY STORAGE SYSTEM (ESS). One or more devices, assembled together, capable of storing electrical, thermal, or mechanical energy in order to supply electrical energy at a future time.

Revise as follows:

C406.1 Requirements. Buildings shall comply with one or more of the following:

1. More efficient HVAC performance in accordance with Section C406.2.
2. Reduced lighting power in accordance with Section C406.3.
3. Enhanced lighting controls in accordance with Section C406.4.
4. On-site supply of renewable energy in accordance with Section C406.5.
5. Provision of a dedicated outdoor air system for certain HVAC equipment in accordance with Section C406.6.
6. High-efficiency service water heating in accordance with Section C406.7.
7. Enhanced envelope performance in accordance with Section C406.8.
8. Reduced air infiltration in accordance with Section C406.9

9. On-site *energy storage system* installed in accordance with Section C406.10

Add new text as follows:

C406.10 On-site energy storage system (ESS). An on-site energy storage system with a storage capacity of at least 50 kWh that is not part of an emergency power system shall be installed. The system shall be capable of interacting with the electric grid or on-site renewable energy system or both.

Reason: According to the US Energy Information Administration (<https://www.eia.gov/analysis/studies/electricity/batterystorage/>), at the end of 2017, there were 708 MW and 867 MWh of large scale energy storage systems in operation in the United States. Several states have enacted policies that require large-scale installations of energy storage systems (over 1,000 MW) to support the growth of renewable electric generation systems on the grid and at buildings. In states with aggressive renewable portfolio standards, energy storage systems are needed to help balance the grid, especially in times of very high supply of renewable energy and low demand (e.g., "the duck curve").

Several utilities throughout the US are providing incentives to customers for installing energy storage systems, based on a minimum capacity. Typically, the minimum capacity requirement has been on the order of 50 kWh or 50 kW for a certain number of hours of discharge.

The definition is needed for clarity to support the for new language for Energy Storage Systems in Section C406.

This is the same definition that is used in the latest version of the *International Fire Code*.

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

This is one of several additional efficiency options that a building owner or designer can choose from in Section C406. Based on the data from the EIA report, the range of costs for an installed energy storage system ranges from \$500 to \$2500 per kWh, depending on the battery size, battery chemistry, and safety code requirements. Battery prices are declining, which will reduce these costs significantly over the next several years. In addition, state and utility incentives in parts of the US significantly reduce the initial costs.

Proposal # 4425

CE265-19